May 22, 1961

Aviation Week and Space Technology

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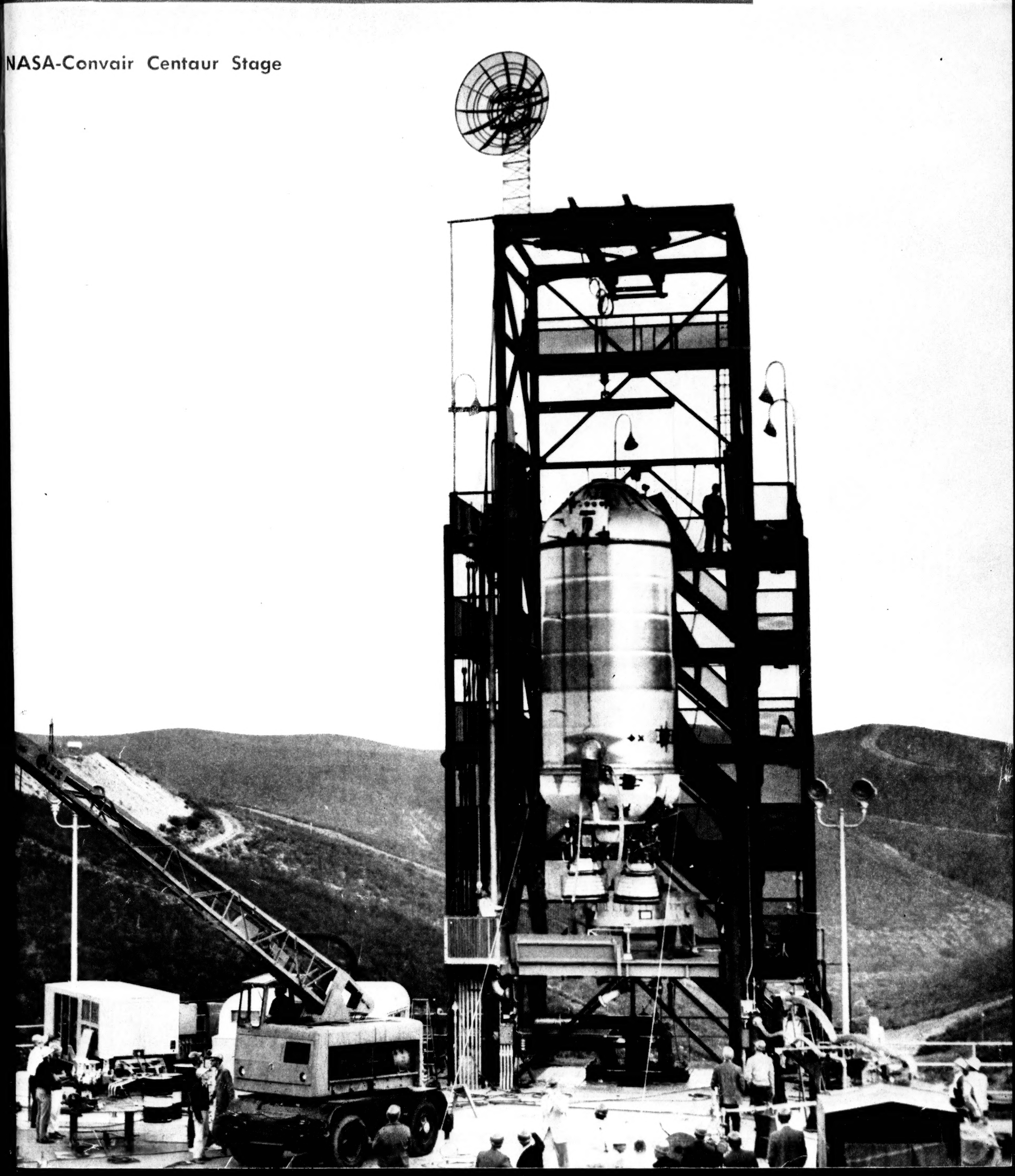
A McGraw-Hill Publication

SPECIAL REPORT:

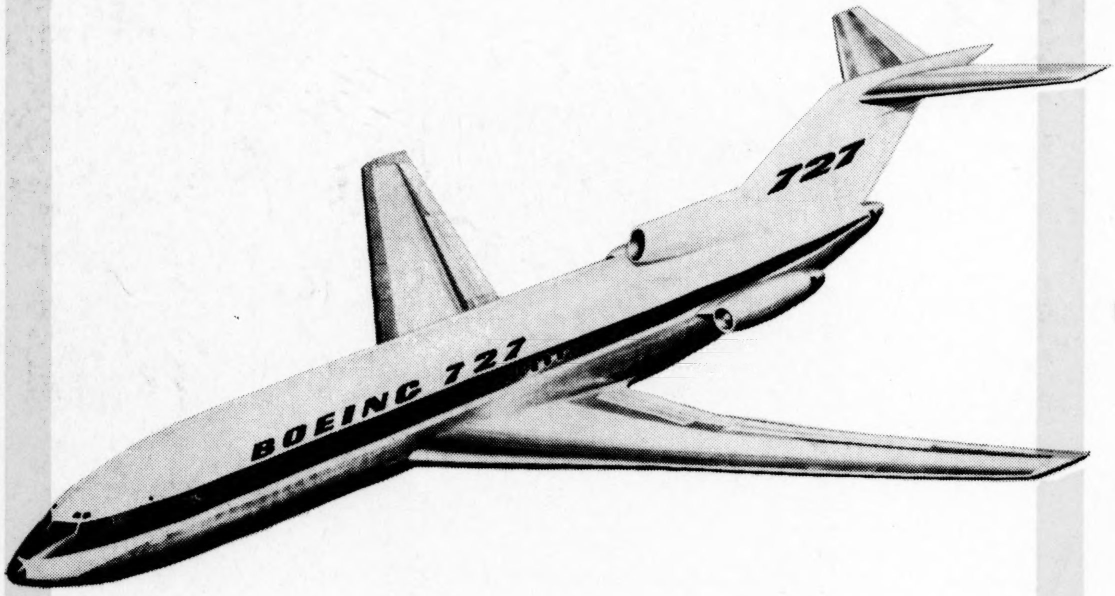
Mercury Capsule Design Evolution

THE UNIVERSITY OF MICHIGAN
MAY 23 1961
ENGINEERING



NASA-Convair Centaur Stage

Setting Aircraft Standards of Progress: Boeing 727



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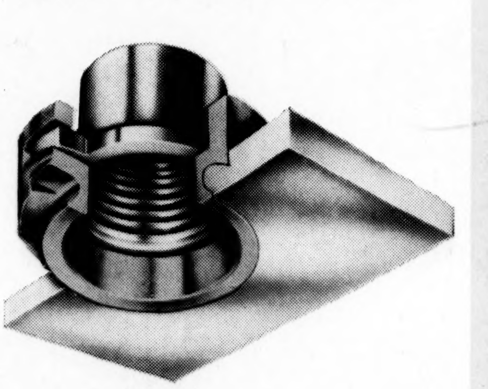

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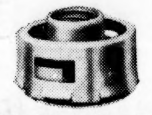
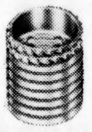
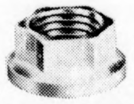
MK 7200 Miniature Stake Nut



MF 7200 Miniature Floating Stake Nut



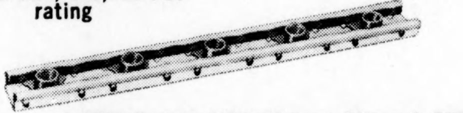
K 8000 High-Strength Thin-Wall Insert



H 14 6-Point Reduced Height Nut, 160,000 PSI rating

HW 14 6-Point Captive Washer Nut, 160,000 PSI rating

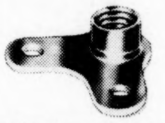
H 10 Hex Nut



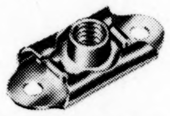
G 1000 Narrow C'Bored Gang Channel, 250°F

K 1000 Two-Lug Anchor Nut

K 2000 One-Lug Anchor Nut

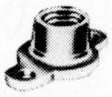


K 3000 Corner Anchor Nut

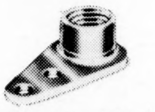


F 5000 Two-Lug Floating Anchor Nut

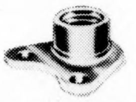
F 2000 One-Lug Floating Anchor Nut



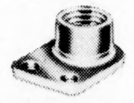
MK 1000 Two-Lug Miniature Anchor Nut



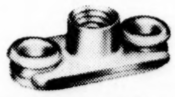
MK 2000 One-Lug Miniature Anchor Nut



MK 3000 Corner Miniature Anchor Nut

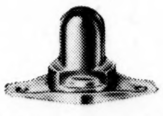


MK 4000 Short-Lug Miniature Anchor Nut



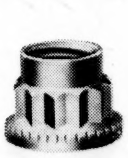
MF 1000 Two-Lug Miniature Floating Anchor Nut

MF 6000 Right Angle Basket Miniature Floating Anchor Nut



F 1968 Two-Lug Self-Sealing Dome Anchor Nut

H 25 12-Point High Fatigue Nut, 220,000 PSI rating



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AVIATION CALENDAR

May 31-June 2—University of Michigan's Seventh Annual Radar Symposium, Ann Arbor, Mich.

June 2-3—12th National Maintenance and Operations Meeting, Reading Aviation Service, Inc., Reading, Pa.

June 6-7—Air Transport Section, National Safety Council, Executive Committee Meeting, Lambert Field, St. Louis, Mo.

June 6-8—International Instrument-Automation Conference & Exhibit, Instrument Society of America, Royal York Hotel, Toronto, Canada.

June 6-11—Golden Anniversary of Naval Aviation, Pensacola, Fla.

June 11-14—Summer Annual Meeting, American Society of Mechanical Engineers, Statler-Hilton Hotel, Los Angeles.

June 12-13—Third National Radio Frequency Interference Symposium, Institute of Radio Engineers, Sheraton Park Hotel, Washington, D. C.

June 13-15—37th Meeting, Aviation Distributors and Manufacturers Assn., Dennis Hotel, Atlantic City, N. J.

June 13-16—National Joint Meeting, Institute of the Aerospace Sciences and American Rocket Society, Ambassador Hotel, Los Angeles, Calif.

June 14-15—Fifth Annual Conference, Product Engineering and Production, Institute of Radio Engineers, Sheraton Hotel, Philadelphia, Pa.

June 18-23—Summer General Meeting, American Institute of Electrical Engineers, Cornell University, Ithaca, N. Y.

June 19-21—Space Flight and Re-entry Trajectories Symposium, International Astronautical Federation's International

(Continued on page 6)

AVIATION WEEK and Space Technology

May 22, 1961
Vol. 74, No. 21

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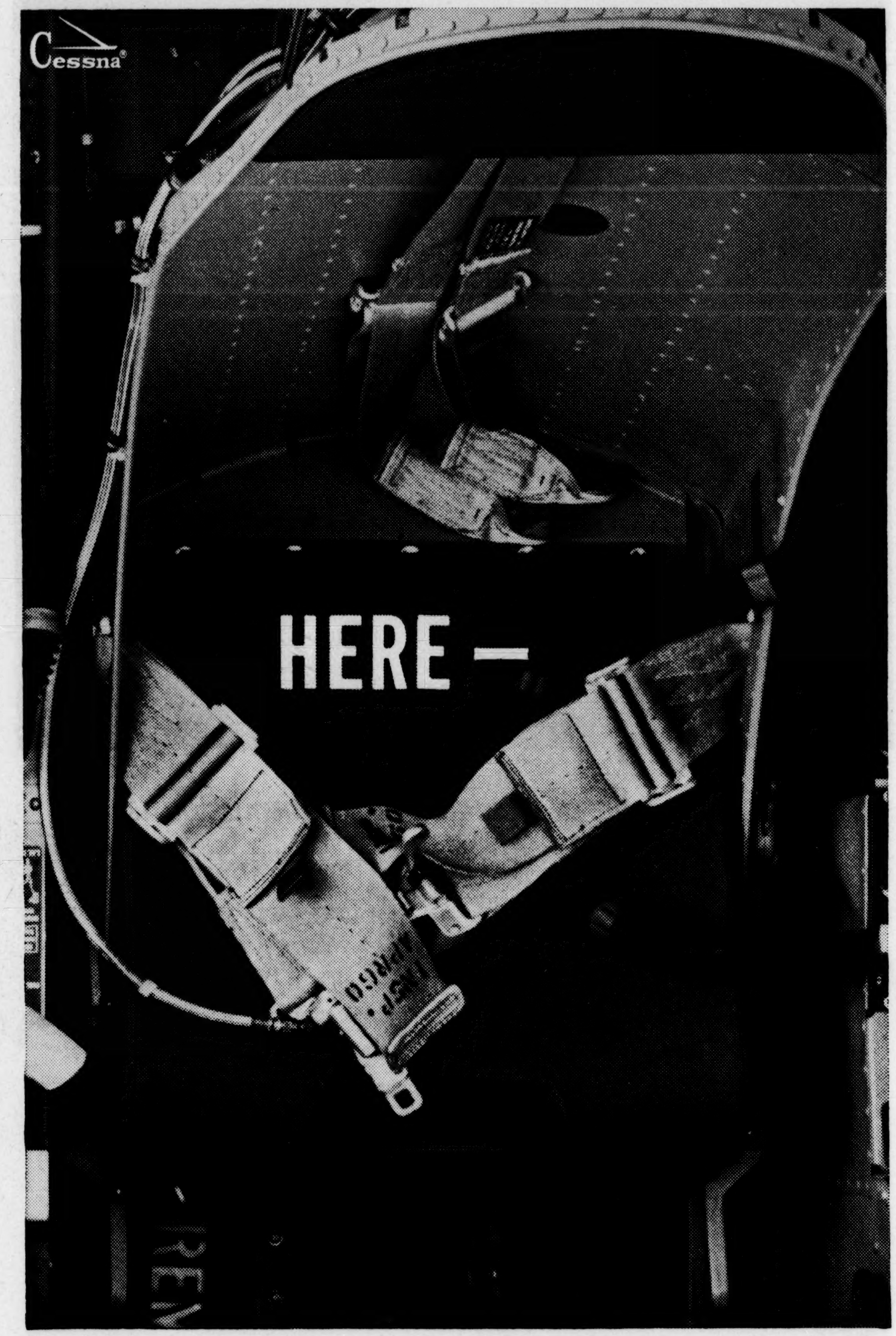

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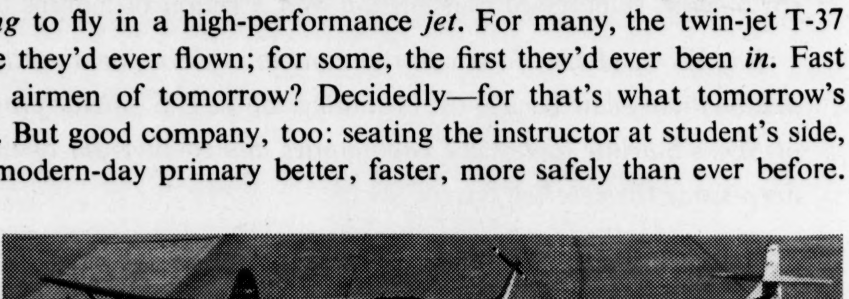

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AVIATION CALENDAR

(Continued from page 5)

Academy of Astronautics, Paris, France.

June 19-21—Institute of Navigation—USAF Symposium on Supersonic Air Transport Navigation, Western Hills Hotel, Ft. Worth, Tex.

June 22-23—Eighth Annual Symposium on Computers and Data Processing, Denver Research Institute, Elkhorn Lodge, Estes Park, Colo.

June 24-27—First Reunion of World War I Overseas Flyers, Air Force Museum, Wright-Patterson AFB, Dayton, Ohio.

June 26-28—Fifth National Convention on Military Electronics, Institute of Radio Engineers, Shoreham Hotel, Washington.

June 26-28—European Symposium on Space Technology, British Interplanetary Society, London, England.

June 26-30—Special Technical Conference, American Institute of Electrical Engineers' Aerospace Transportation Committee, Benjamin Franklin Hotel, Philadelphia.

June 27-29—International Symposium on Analytical Astrodynamics, Santa Barbara, Calif. (Contact: Capt. J. L. Gilbert, Air Force Office of Scientific Research, Washington 25, D. C.)

June 28-30—Joint Automatic Control Conference, University of Colorado, Boulder.

June 28-July 1—Annual Meeting, Institute of Navigation, Williamsburg Inn, Williamsburg, Va.

July 17—Air Force Contract Aviation Services Symposium, National Aeronautical Services Assn., Hotel Washington, Washington, D. C.

July 24-26—Air Traffic Control Facilities Symposium, Electronic Maintenance Engineering Assn., Mayflower Hotel, Washington, D. C.

July 25-Aug. 10—International Trade Fair and Aviation Exhibition, McCormick Place Exposition Center, Chicago, Ill.

Aug. 1-3—Fourth Western Regional Meeting, American Astronautical Society, Sheraton-Palace Hotel, San Francisco, Calif.

Aug. 7-9—Guidance and Navigation Conference, American Rocket Society, Stanford University, Palo Alto, Calif.

Aug. 15-17—Cryogenic Engineering Conference, University of Michigan, Ann Arbor, Mich.

Aug. 16-18—International Hypersonics Conference, American Rocket Society, Massachusetts Institute of Technology, Cambridge, Mass.

Aug. 22-25—Western Electronic Show and Convention, Cow Palace, San Francisco.

Sept. 4-10—1961 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 4-14—Eighth Anglo-American Conference, Institute of the Aerospace Sciences, London, England.

Sept. 6-8—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, University of New Mexico, Albuquerque, N. M.

Sept. 10-12—National Convention, National Aeronautic Assn., Westbury, N. Y.

Oct. 2-7—12th International Astronautical Congress, Washington, D. C.

Oct. 9-13—American Rocket Society's 16th Annual Meeting & Space Flight Report to the Nation, Coliseum, New York, N. Y.

May 22, 1961

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and Space Technology

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▶$9.6 billion authorized for aircraft and missiles, marking shift to manned bomber, conventional war.

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▶Capsule design was done in parallel with its testing by NASA and McDonnell; astronaut's safety tops requirements.

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EDITORIAL

Khrushchev Really Means It........ 17

COVER: Centaur second stage is being prepared for flow control tests at Sycamore Canyon Rocket Test Site, northeast of San Diego, Calif. Valves and other plumbing hardware were checked out before vehicle was returned to General Dynamics/Astronautics, San Diego. Centaur, powered by two Pratt & Whitney LR-115 15,000-lb. thrust liquid hydrogen engines, will be used with the Atlas D booster and with some Saturn configurations (AW Apr. 24, p. 30).

PICTURE CREDITS

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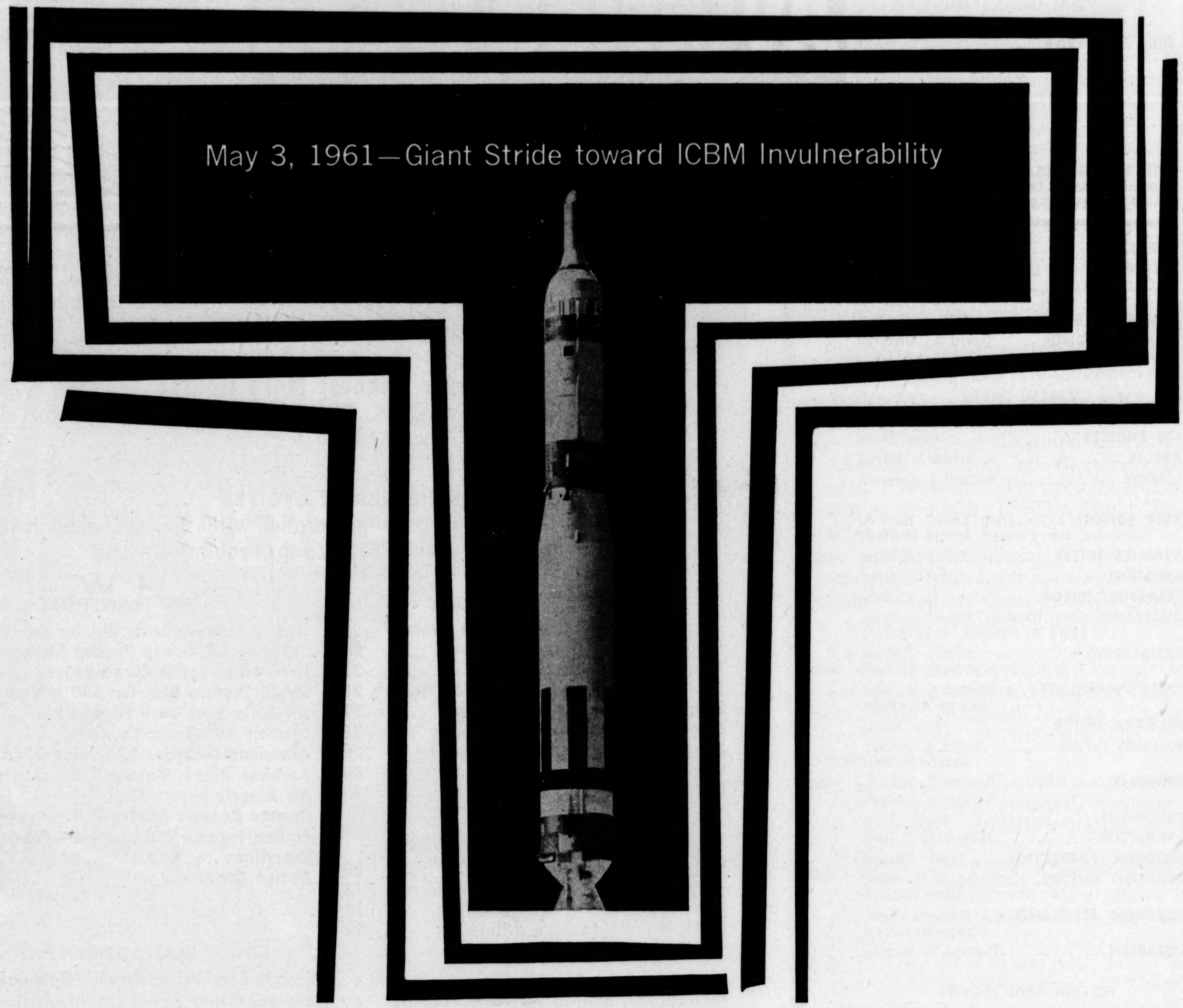
85,186 copies of this issue printed

TITAN—newest triumph of **S**pace **T**echnology **L**eadership



The nation's first in-silo launch of an ICBM marks a major milestone in the timely development of USAF Titan—and a signal success for an industrial team led by scientists and engineers of Space Technology Laboratories, Inc., under Air Force program management. This successful test confirmed the STL design solution to the unparalleled vibration problems created by the roar of Titan's 300,000-pound thrust booster engine within the confines of its 10-story underground silo. ■ Two years ago, studies by STL as contractor to the Air Force for systems engineering and technical direction of the Titan program, indicated that in-silo launching which provided invulnerability and enormous economy was technically attainable. But one major problem had yet to be solved: proper control of the noise-created vibration during the first few seconds of in-silo firing which, if uncontrolled, would literally shake apart the 97-foot Titan. Research and analysis by STL produced the solution, verified by the dramatically successful test at Vandenberg Air Force Base on May 3, 1961. ■ The successful launch of Titan I demonstrated the soundness of STL silo design concepts for the Air Force Titan II program. Titan II is a fast reacting, highly flexible weapon of maximum range and destructive capability—a new and potent element in deterring aggressor attack. ■ Today STL scientists and engineers are actively engaged in the program that is producing soon-to-be-operational Titan I and quick-reacting Titan II. Their responsibilities in this, as well as in the Atlas and Minuteman programs, create career opportunities for additional numbers of outstanding scientists and engineers. For opportunities with STL in Southern California or at Cape Canaveral, please write to Dr. R. C. Potter, Manager of Professional Placement and Development, at either location.

TITAN TEAM. Program Management: Ballistic Systems Division, Air Force Systems Command. **Major Associate Contractors:** Space Technology Laboratories, Inc., systems engineering and technical direction; The Martin Co., airframe, assembly, and test; Bell Telephone Laboratories and Remington-Rand UNIVAC, radio guidance; AC Spark Plug, all-inertial guidance; Aerojet General, propulsion; Avco Corp. and General Electric, re-entry vehicles; American Machine & Foundry, silo-lift launcher system; A. D. Little, propellant loading system; Daniel, Mann, Johnson, Mendenhall & Assoc. and Ralph M. Parsons Co., architects and engineers; Kellogg Switchboard & Supply Co. and Stromberg-Carlson, communications.

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EDITORIAL

Khrushchev Really Means It

(A great deal of the Kennedy Administration's time and effort has gone into a search for the political techniques and balance of forces necessary for dealing effectively with the spreading perimeter of Communism. Because the results of this search affect those in the aerospace industry even more directly than they do most citizens, Aviation Week *is publishing this appraisal of the world situation and of Soviet intentions. It is the last of a series of columns written recently by Stewart Alsop, national affairs editor of the Saturday Evening Post, for his brother Joseph's column, "Matter of Fact," syndicated by the New York Herald Tribune.—Ed.)*

This reporter feels a bit like a dying man who wants to be remembered for his famous last words, but can't think of any. The best I can do is: Khrushchev really means what he says.

The British could never quite bring themselves to believe that Hitler really meant the crazy things he said in "Mein Kampf." But Hitler did mean them, because he was crazy.

Nikita Khrushchev is not crazy. Unlike Hitler, he has no irrational impulse to play Samson in the temple. But it is important to realize that Khrushchev and those around him are rational within the limits imposed by the essentially irrational doctrine of Marxism-Leninism. This doctrine makes it possible for Khrushchev, like the White Queen, to "believe six impossible things before breakfast," as when he remarked, in Walter Lippmann's fascinating interview with him, that he considered President Kennedy merely an agent of the Rockefeller interests.

World Soviet Republic

No doubt Khrushchev really believes this. More important, there is no doubt at all that he really believes that what his idol Lenin called "the cause of creating a world-wide Soviet Republic" is sure to triumph, and rather soon now. Indeed, in recent months he has been predicting that triumph more confidently than ever before.

He has been quite explicit, moreover, about how the triumph is to be achieved. He announced gloatingly more than a year ago that "the world balance of power has now turned sharply in favor of the socialist countries." In his dispute with the Chinese Communists, he has ruled out the use of this power in a global nuclear war in order to insure the triumph of the "world-wide Soviet Republic." But, he says, "we shall make the imperialists jump like fishes in a saucepan, even without war."

By "imperialists" he means us, and in Southeast Asia, Cuba, and elsewhere, we have indeed been jumping like fishes in a saucepan. Moreover, Khrushchev has also been quite explicit about what he means by "without war." He means without the kind of war which might destroy the Soviet Union. Other wars are dandy. "We support wholeheartedly and without reservation all national liberation wars," he said a few weeks ago.

This is the kind of war Khrushchev and the Chinese and Indo-Chinese Communists have been promoting in Southeast Asia. It is wholly predictable that there will be more such wars, not only because Khrushchev means what he says, but because he must prove to the Chinese that he is, as a Communist, more royalist than the king.

Continuous Cold War

Once you assume that Khrushchev means what he says, certain things become clear. One is that the cold war will go on, perhaps for generations. When the Kennedy Administration took office, there were those in the Kennedy inner circle who talked hopefully of negotiating a "package deal," which would include arms control and a mutual agreement to "call off the cold war." These hopes have now, of course, turned to ashes.

The reason they have turned to ashes is simple. To ask the Communist leaders to forbear to thrust for Communist power in any area they deem vulnerable is to ask them to cease to be Communists. This is from their point of view non-negotiable. The alternative is an agreement by our side not to respond to Communist thrusts, and to await meekly the destruction of our system. From our point of view, this also is surely non-negotiable.

As in the Korean truce or the first Berlin blockade, it is possible to negotiate with the Soviets temporary accommodations which reflect the current realities of power. Unfortunately, the current realities of power are suggested by the fact that, if President Kennedy had intervened in either Cuba or Laos—let alone both—he would have had to commit just about the entire pathetic corporal's guard of conventional forces at his disposal. It is not surprising that Khrushchev was not much frightened by the President's bold words about Laos.

Mr. Kennedy's first job is thus to right the real power balance. If the job is done, there is no reason to despair, despite the recent disasters. For the other side has grave weaknesses which are less visible than ours, and the President, although he has blundered badly, is still capable of offering the leadership the West so desperately needs. But the job will be expensive and painful, and it will not be done unless we recognize that when Khrushchev predicts that our system will be destroyed by his, he means just that. If all this seems a bit obvious and unsubtle, so are most last words.

YES, THE ANSWER IS NO!

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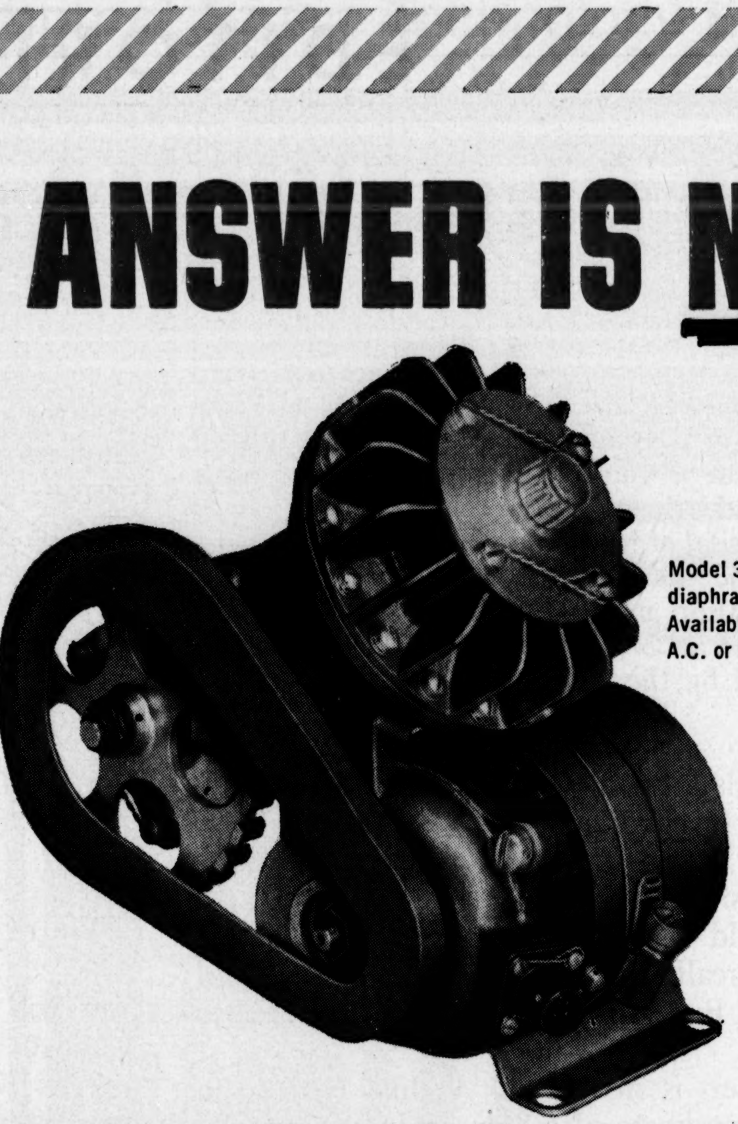
NO HEAT

NO LUBRICATION

NO CARBON DUST

NO "OILY" AIR

NO LOSS OF CAPACITY



Model 373 Single Stage diaphragm pump. Available with A.C. or D.C. motor

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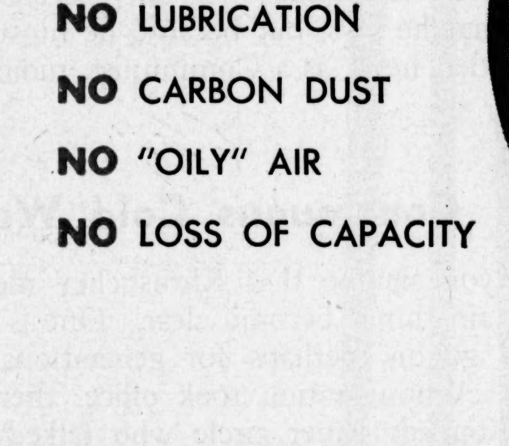

Model 283 two stage Cornelius pressurization pump for service to 60,000 feet without aid of inlet pressurization. Weight: 6.5 lbs. Delivers 200 cu. in. per minute of standard air at 25 psi at 60,000 feet.

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Pioneers in pneumatic systems for aircraft.

WHO'S WHERE

In the Front Office

Maj. Gen. William L. Rogers, USAF, will become commander of the Arnold Engineering Development Center on July 1, replacing **Brig. Gen. Homer Boushey,** retiring **Col. Harry J. Sands, Jr.,** replaces Gen. Rogers as vice commander of the Air Force Missile Test Center.

Brig. Gen. E. B. LeBailly, commander, U. S. Forces, Azores, and commander of the Military Air Transport Service 1605th Air Base Wing at Lajes Field, Azores. Gen. LeBailly now is USAF deputy chief of information.

Herbert H. Rogge, a director and chairman of the executive committee, Burndy Corp., Norwalk, Conn.

Charles A. Coolidge, Boston attorney, has been named chairman of the board of trustees of the Mitre Corp., Bedford, Mass.

Howard C. Pyle, a director, Acoustica Associates, Inc., Los Angeles, Calif. Mr. Pyle is president of Monterey Oil Co.

Dr. E. J. Warlow-Davies, a director of Bristol Siddeley, London, England. Dr. Warlow-Davies is chief engineer (aero) of the company.

Even T. Collinsworth, Jr., president and chief administrative officer of Fansteel Metallurgical Corp., North Chicago, Ill., succeeding **Dr. Frank H. Driggs,** now board chairman.

Richard Candelaria, president of the newly formed American Orbitronics Corp., Washington, D. C.

H. Edward Rice, vice president-operations, Philco Corp.'s Government and Industrial Group, Philadelphia, Pa.

Robert E. Parrett, corporate vice president and general manager, Pacific Automation Products, Inc., Glendale, Calif.

Louis H. Aricson, chief executive officer of the Weston Instruments Division of Daystrom, Inc., Newark, N. J. Mr. Aricson continues as corporate vice president. Also: **Joseph F. Degen,** assistant vice president-manufacturing.

David S. McNally, vice president and director of marketing, Industrial Products Division of International Telephone and Telegraph Corp., San Fernando, Calif.

William T. Lake, controller, General Dynamics Corp., New York, N. Y. Also: **John F. Thurston,** a senior vice president and president of General Dynamics' Liquid Carbonic Division, Chicago, Ill.

H. V. Brantly, a vice president, U. S. Science Corp., Los Angeles, Calif., a subsidiary of United Industrial Corp.

William A. Tweedie, vice president and general manager, Ling Electronics Division of Ling-Temco Electronics, Inc., Anaheim, Calif.

Roy B. Snapp, divisional vice president of American Machine & Foundry Co., in charge of the Washington, D. C., office.

Rear Adm. Rawson Bennett (USN, ret.), a senior vice president and director of engineering, Sangamo Electric Co., Springfield, Ill.

Donald E. Young, assistant vice president-general, Burroughs Corp., Detroit, Mich.

(Continued on page 98)

INDUSTRY OBSERVER

▶ Boeing's reluctance to use Air Force PEP management technique on its Dyna-Soar program, despite USAF's urging, has resulted in apprehension that the program may be slipping behind its original timetable. With the exception of Boeing, adoption of the Navy/Air Force PERT/PEP technique (AW Nov. 28, p. 85) is spreading rapidly in the aerospace and avionics industry. Some companies, such as Collins Radio, are applying it across the board, including non-military development programs.

▶ Advanced Research Projects Agency's proposed satellite surveillance system ARPA No. 162-61, originally called Project Lofter, may have offensive capability to supplement its ability to detect hostile ballistic missile launchings with infrared and ultraviolet sensors. Five study contracts for the program are now expected to be awarded about June 1.

▶ Lockheed Georgia Division plans to propose a boundary layer control C-130 transport, powered by an advanced version of the Rolls-Royce Tyne turboprop, to European nations. The aircraft would achieve its STOL performance by bleeding air directly from the Tyne engines, eliminating the auxiliary turbines now required on the Allison T-56 powered C-130 BLC prototype. Lockheed will take the prototype on a European sales tour after it is demonstrated at the Paris Air Show.

▶ Defense Department is seeking means under a project called Last Ditch to defend against missiles which might penetrate a Nike Zeus defense system. Last Ditch concept would accept some damage in the target area. Douglas Aircraft Co., Nike Zeus airframe contractor, has a study contract under the project.

▶ Army probably will get the job of managing Advanced Research Projects Agency's new terminal ballistic missile defense program, called ARPA Terminal (Arpat), under a Defense Department rule assigning the service responsibility for terminal defense projects. Arpat contract award (AW Apr. 10, p. 26), expected by May 20, has been delayed.

▶ Each Atlas ICBM squadron is budgeted for $16 million operating costs in Fiscal 1962, covering military and civilian personnel, base operations, replacement parts and maintenance. Each squadron has 10 missiles, including one spare. Titan ICBM squadrons are expected to have approximately the same costs.

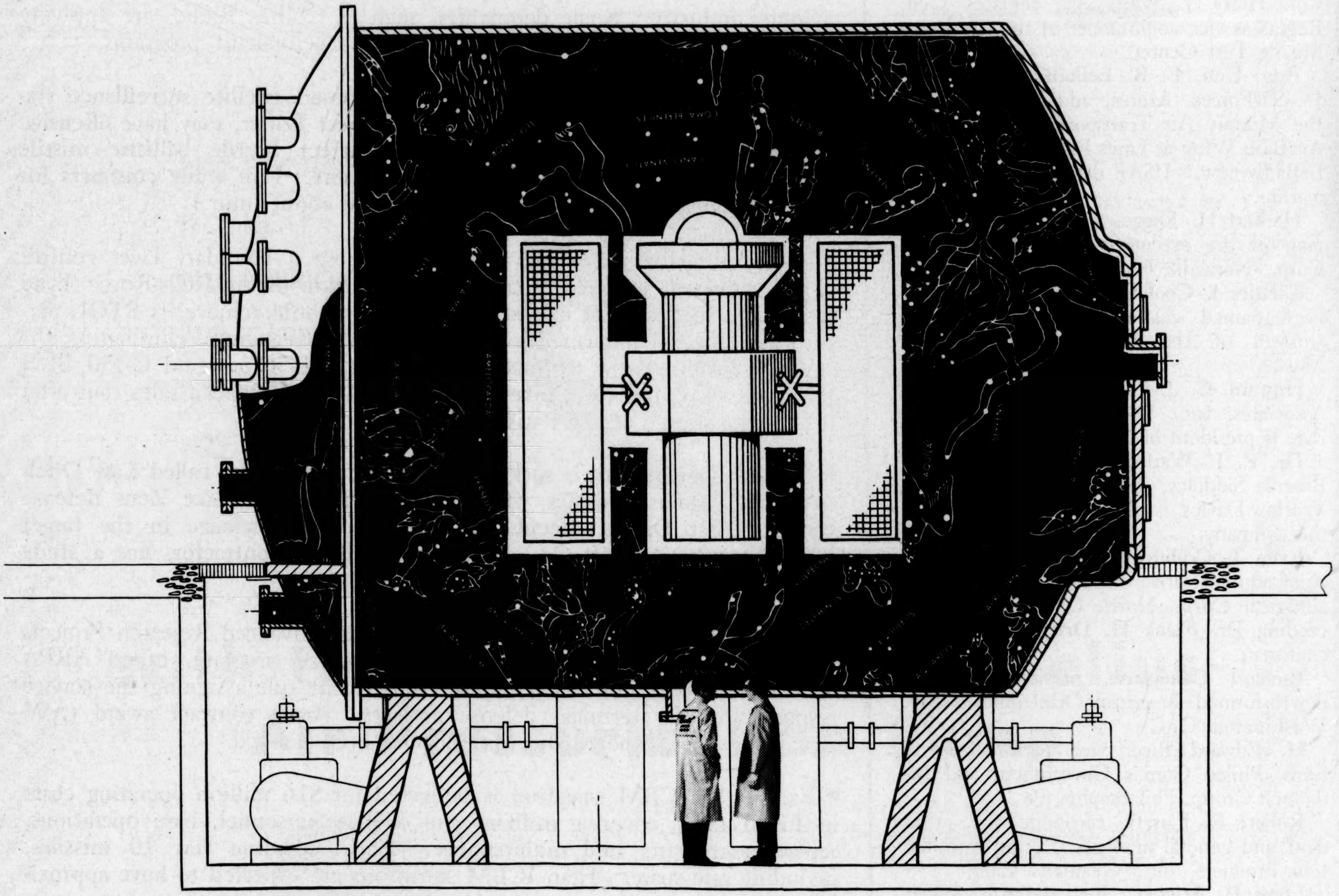
▶ Modification of the Republic F-105 tactical fighter to improve its capability for non-nuclear war missions includes increasing thrust of the Pratt & Whitney J75 turbojet by 1,000 lb., adding a boom receptacle for refueling from Boeing KC-135 tankers and installation of pylons to carry much heavier payloads, including the Martin Bullpup missile.

▶ Air Force is expected to quadruple spending in the new field of bionics during Fiscal 1962. Aeronautical Systems Division's Electronics Technology Laboratory, which funded eight bionics contracts worth a total of about $500,000 this year, hopes to get $2 million next year.

▶ NASA is expected to request proposals in September for a 100-kw., 2,000-mc. C-W transmitter for its Goldstone, Calif., tracking facility. The agency's Jet Propulsion Laboratory is preparing specifications. Similar units may be purchased later for stations at Woomera, Australia, and Johannesburg, Union of South Africa.

▶ Air Force is diverting 17 Boeing KC-135 tankers now in production to the transport configuration in order to permit delivery of C-135s to begin next month and continue at the rate of two per month until the order for 30 is completed. Diversion is part of the attempt to increase airlift capability rapidly.

▶ Marine Corps designation for the Boeing-Vertol light assault helicopter based on the Model 107 II is HRB. Fiscal 1962 budget requests cover an initial purchase of 14 vehicles.



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Washington Roundup

Challenge to Brooks

Kennedy Administration has made a move to loosen Chairman Overton Brooks' tight grip on the House Science and Astronautics Committee by asking House Majority Leader John W. McCormack of Massachusetts to return to its membership. Rep. McCormack played a major role in writing the national space act in 1958 but has stayed in the wings on space affairs since then.

After a resolution adding Rep. McCormack to the committee passed the House quietly last week, the majority leader denied the Administration had anything to do with it. But it is known that Administration leadership wanted someone on the committee powerful enough to rein in Rep. Brooks. With the majority leader's powers over committee appointments and legislation, Rep. McCormack can do just that. He told AVIATION WEEK he returned only because friends among the membership wanted him to out of "their respect and friendship to me."

Rep. Brooks has been holding hearings almost every day—often with little staff preparation—for all 25 members of the committee, almost never using the subcommittees. He requires a set quota of press releases to be issued. His dominance of the committee led several members to discuss a revolt earlier this year but it did not materialize.

The chairman said he is glad to have Rep. McCormack join the committee, and said he does not see "how he would affect my role as chairman." He said he has been calling the full committee so everyone can be educated at once about space, and said there is no logical way to break down space subjects by subcommittees.

Nevertheless, the addition of Rep. McCormack, the Administration's determination to show the "sense of urgency" in space that Rep. Brooks has called for, the resentment of the committee's younger members, and the resurgence of activity in the Senate space committee are all combining to diminish Chairman Brooks' role.

Criticism of FAA

Air Force is becoming increasingly critical of the way Federal Aviation Agency is handling its assignments for the military. FAA's upcoming evaluation of the AN/GSN-11 (Volscan) return-to-base computer this fall may be made a test case.

To evaluate capability of the Avco-designed GSN-11, which is intended to handle up to 18 aircraft simultaneously, USAF has asked FAA to make a total of 3,000 live aircraft approaches during the several month test period, but FAA's counter-proposal calls for only 70 approaches. Earlier, USAF criticized the adequacy of the agency's evaluation of the AN/GSN-5 automatic landing system, with the result the FAA scheduled a new evaluation.

Civil Aeronautics Board has told Congress that the U.S. is penalizing its own flag carriers by sticking to principles of the 1947 Bermuda agreement with Great Britain in its bilateral air talks with other nations. Frequency of flight principle, which other nations often refuse to honor, specifically is causing losses for U.S. carriers, and CAB Chairman Alan S. Boyd says some or all of the principles may have to be abandoned.

General Electric's newly formed Communication Satellites, Inc., has opened an office in Washington, an indication that GE intends to push hard for government and industry support for its "common carriers' common carrier" commercial communications satellite system concept.

Rubel's Nomination

Nomination of John H. Rubel to be an assistant secretary of defense in addition to his job as deputy director of defense research and engineering clarifies the status of the DDRE directorship held by Dr. Harold Brown and strengthens Rubel's hand in his dealings with other assistant secretaries, such as the comptroller, and with assistant service secretaries for research and development.

Brown's position has ranked above those of assistant defense secretaries since it was created, but this has not been universally recognized. Rubel wanted to remain in his post under Brown but also wanted an appointive job. Defense Secretary Robert McNamara showed his appreciation for the job Rubel has done by giving him the appointment. McNamara had cut out two assistant secretaryships before, now has added Rubel's position.

USAF Chief of Staff Gen. Thomas D. White's request for retirement has confused the picture on who will succeed him. Pentagon insiders had expected him to finish out the year, but as of late last week he had not been asked to stay. Retirement of Gen. Curtis LeMay, White's deputy chief, had been expected but his name now leads the list in speculation on who will take the top job, with Lt. Gen. Frederic H. Smith most frequently mentioned as vice chief.

Secretary McNamara has asked the services for so many position papers that some time ago, when the number reached 76, they began to be known as the "76 trombones." But the requests continued, and as of last week McNamara's band had 146 trombones.

—Washington Staff

Senate Vote Emphasizes Proven Weapons

$9.6 billion authorized for aircraft and missiles, marking shift to manned bomber, conventional war.

By Katherine Johnsen

Washington—Senate voted unanimously last week to authorize $9.6 billion for Fiscal 1962 aircraft and missile procurement in legislation marking a shift in emphasis from nuclear-armed intercontinental missiles to manned strategic aircraft and to the conventional weapons of limited warfare.

Presenting the measure to the Senate, Sen. Richard Russell (D.-Ga.), chairman of the Armed Services Committee, explained the purpose of committee members in adding $525 million to the Administration program (AW May 15, p. 27):

"To some members, the most persuasive argument for taking this action is that manned bombers constitute a proved system, while intercontinental ballistic missiles are new, and have many complexities and uncertainties.

"Other members may have been motivated by the realization that a state of mutual deterrence, or an effective agreement banning atomic weapons, might leave us inadequately prepared in systems to respond to conventional warfare. Still other members were impressed by the more deliberate response that may be made with manned systems and by the greater utility and flexibility that these systems afford.

Another justification for procuring more manned bombers is to assure adequate launching vehicles for the standoff missiles such as Hound Dog and Skybolt. Some of the B-52s in our current force are already several years old. By the time the Skybolt development is completed and this missile system is operational, a substantial part of the B-52 force may be approaching the end of the period of effective use."

Compromising Additions

The $525 million added by the Senate will be compromised with these three additions to the Administration program approved by House Armed Services Committee as congressional action is completed on the Fiscal 1962 procurement authorization: $337 million for strategic bombers; $21.2 million for turbofan engines for 15 Boeing C-135 cargo aircraft in place of turbojet engines, and $25 million for three long-range jet passenger transports for executive use.

At hearings before both House and Senate committees, Air Force and Defense Department stated that additional strategic bomber funds would be invested in Boeing B-52s, rather than Convair B-58s. Both House and Senate versions of the measure leave the selection to Defense.

In its report, Senate Armed Services Committee said: "In the committee's opinion, the B-52 is the most effective long-range manned aircraft that can be procured immediately." During hearings, Rep. Carl Vinson (D.-Ga.), chairman of House Armed Services, and Rep. Leslie Arends (R.-Ill.), ranking minority member, also stated their preference for the B-52.

Rep. James Wright (D.-Tex.), alleged weaknesses in the B-52 and urged further procurement of the B-58 when he testified at the House hearings.

Both the B-52 and B-58 production lines are scheduled to close down in mid-1962 unless there is further financing. The Administration budget contains no funds for either the B-52 or B-58.

Commenting on the $337 million added to continue strategic bomber production, the House committee report said:

"Who knows whether an intercontinental ballistic missile with a nuclear warhead will actually work? Each of the constituent elements has been tested, it is true. Each of them, however, has not been tested under circumstances which would be attendant upon the firing of such a missile in anger.

"By this the committee means an intercontinental ballistic missile will carry its nuclear warhead to great heights, subjecting it to intense cold. It then will arch down and upon reentering the earth's atmosphere subject the nuclear warhead to intense heat. Who knows what will happen to the many delicate mechanisms involved in the nuclear warhead as it is subjected to these two extremes of temperature?

"The scientists may say that all these things are determinable by extrapolation. Perhaps this is so. To the committee, however, it seems that our only knowledge of the actual workability of an ICBM fired in anger is in textbooks and in laboratories. The committee is unwilling to place the safety of this country in a purely academic attitude. . ."

Sen. Russell reported to the Senate that the weapons of conventional warfare are "the trend in defense plans for the immediate future." As a result of the review of the defense posture now under way at the Pentagon, he anticipated the Administration will request authorization for a further build-up of airlift and that "other steps to improve our conventional forces will be forthcoming."

Despite strong support for a "fly early" Aircraft Nuclear Propulsion program from Rep. Melvin Price (D.-Ill.) during the hearings, House Armed Services concurred with the Administration plan to drop both the General Electric Co. direct cycle and the Pratt & Whitney indirect cycle approach and reduce the program to a research effort. Commenting that neither approach "holds any great promise as a practical propulsion unit in the foreseeable future," the committee report observed:

The direct cycle system "is extremely cumbersome and requires an excessive amount of heavy shielding against radiation hazards. In operation, the system would expel some small fraction of radioactive fission products into the atmosphere, creating an important public relations problem if not an actual physical hazard."

On the indirect cycle, the report added: "With over 15 mi. of fine tubing carrying liquid metal at very high temperatures and thousands of welded joints involved, the possibility of a leak constitutes a severe hazard. This design . . . does not appear to be very practical for a combat aircraft."

All ANP aircraft, the report said, "would be very large—gross takeoff and landing weight would be in the order of half a million pounds at least. All will present novel, and probably severe, operational and ground handling problems and hazards, both during normal operations and especially in the event of a crash." Because high speed will involve heavy shielding, the committee said that with present system designs, "attainment of supersonic speeds appears extremely difficult."

Both the House and Senate versions of the authorization measure provide the $220 million proposed by the Administration for development of the B-70. Air Force made a strong plea for additional funds to both Armed Services committees.

In addition to the strategic bombers and other possible additions by Congress, the Fiscal 1962 purchases proposed by the Administration and approved by the Senate and House Armed

Services Committees are as follows:

- **Air Force aircraft, $3.3 billion.** With carry-over funds, this will provide $3.5 billion for: Boeing KC-135 jet tanker, $230 million; Republic F-105D tactical fighter, $370 million; Northrop T-38 jet supersonic trainer, $129 million; North American T-39 utility trainer, $50.3 million; Lockheed T-40 mission support aircraft, $19.1 million; guided air-to-air rockets, $40 million; North American B-70 bomber, $218 million; Republic RF-105 tactical reconnaissance aircraft, $27.5 million; Lockheed RC-130 mapping aircraft, $7.4 million; Lockheed C-130E transport, $237 million; Lockheed C-141 transport, $98 million; modifications, $672 million; common in-service aerospace ground equipment, $87.7 million; component improvement, $46 million; industrial facilities, $23 million; replenishment spares, $875 million.

Of the $670 million for modifications, $260 million is earmarked for the B-52; $50 million for the F-105, and $18.5 million for the B-58.

- **Air Force missiles, $2.8 billion.** This is divided: Atlas ICBM, $202 million; Titan ICBM, $1.1 billion; Minuteman ICBM, $924 million; Hound Dog air-launched missile, $90.4 million; Hound Dog airborne alert, $41 million; Bullpup air-launched missile, $16.3 million; Bullpup trainer, $10.4 million; Q-2C drone, $10.9 million; ballistic missile support, $180 million; modifications, $25 million; in-service support, $22.8 million; component improvement, $4 million; industrial facilities, $14 million; undisclosed projects, $122 million.

The total investment in Atlas through Fiscal 1962 will be $3.8 billion. The total investment in Titan through Fiscal 1964 will be $4.2 billion. The total for Minuteman through Fiscal 1964 was reported at $12.1 billion.

- **Navy aircraft, $1.6 billion.** This provides for 644 aircraft, including 180 Douglas A4D-5; 24 Grumman A2F-1; 88 McDonnell F4H-1; 72 Chance Vought F8U-2N; 48 Kaman HU2K-1; 42 Sikorsky HSS-2; 70 Sikorsky HUS-1; 36 Lockheed P3V-1; 48 Grumman S2F-3; 12 Grumman W2F-1; 14 Boeing-Vertol HRB; 10 North American T-39.

These types are also in the program in undisclosed quantities: Douglas A4D-2N; North American A3J-1; Lockheed GV-1; Lockheed C-140. Additional funds: product improvement and test engines, $15.8 million; aeronautical spare parts, $421 million; industrial facilities, $5 million; modernization, $50 million.

- **Navy missiles, $606 million.** Plus $27 million for Marine Corps missiles. The total includes $246 million for these types: Sparrow III, Sidewinder 1C, Terrier, Tartar, Talos, Bullpup, Regulus I and Subroc. In addition, the program includes $8.7 million for antisubmarine drone helicopters; $1 million for industrial facilities; $4.8 million for astronautics, and an undisclosed amount—apparently in the neighborhood of $300 million—for Polaris missiles.

- **Army aircraft, $211 million.** This includes: 242 Bell Iroquois helicopters, $67.6 million; 24 Boeing-Vertol Chinook helicopters, $35.4 million; 48 de Havilland Caribou STOL transports, $30.2 million; 48 Grumman Mohawk surveillance aircraft, $42.8 million; 14 Beech Seminole transports, $1.8 million, plus $33.2 million for spare parts, installation kits and transportation to initial destination.

- **Army missiles, $551 million.** The types to be procured are: Hawk low altitude defense; Nike-Hercules air defense; Redeye man-transportable air defense; Honest John short-range; Little John free rocket; Pershing solid propellant guided missile and Sergeant solid propellant guided missile.

'Closed Door' Information Policy Producing Many Inconsistencies

Washington—Defense Secretary Robert S. McNamara's "closed door" information policy—now being improvised and operating without definite guidelines—is characterized by widespread inconsistencies and apparent absurdities.

The situation became clear with the release of volumes of testimony before House and Senate Armed Services Committees.

For example, the dollar amount for each type of Air Force missile and aircraft to be purchased in Fiscal 1962 was made public (see above report). The total cost of each of USAF's three intercontinental ballistic missile programs—Atlas, Titan, Minuteman—as well as the unit cost of each of the missiles was given. But the dollar amount to be spent on each type of Navy aircraft in Fiscal 1962 was "deleted" for security.

In the case of the Army, at one point in the hearings the number of each aircraft to be purchased was made public, and at another point in the text this was "deleted."

After criticizing criticism of Nike Zeus and informing senators that "what we ought to be saying is that we have the most perfect anti-ICBM system that the human mind will ever devise," McNamara—in the released text—proceeded to express apprehensions and uncertainties toward Nike Zeus as well as the Midas ballistic missile warning satellite, the B-70 Mach 3 bomber, and other key weapon programs.

The two public repercussions in Congress last week to McNamara's plan to tighten the release of security information were:

- **Sen. Richard Russell** (D-Ga.) in a floor speech encouraged the secretary to move fast and far. Calling on Defense Department to "make a new start in their policies on publicizing the details of our defense program," Russell commented: "It is not inconceivable that we could destroy ourselves by insisting upon a full exercise of the privilege of knowing the most intimate defense secrets."
- **Sen. Stuart Symington** (D-Mo.) charged in a floor speech that Defense Department had made lengthy deletions from the text of the Senate Armed Services Committee testimony "for public relations reasons only." He accused Defense Department of not practising what McNamara is preaching, and pointed to a publication of the U.S. Army Command and General Staff College, Fort Leavenworth, Kans., giving detailed information on the location of Russian missile launching pads.

Sen. Symington said the Army dismissed the article as a compilation of previously published information. He said that it was at odds with information given by Central Intelligence Agency at top-level briefings.

Behind much of the congressional support for a clamp down on information is the belief of many members that the military services and defense contractors push information favorable to their weapons systems to build constituent pressure.

In a "clarification" of McNamara's testimony that Nike Zeus should be publicly presented as "the most perfect anti-ICBM system," a "Department of Defense spokesman" explained in a press release last week:

"Secretary McNamara preceded this by a sentence raising the question 'Why should we tell Russia that the Zeus developments may not be satisfactory?' Secretary McNamara had in mind the enormous advantages to Russia of our disclosing difficulties which might develop in new weapons systems.

"Under no circumstances does Secretary McNamara feel that the American public should be misled about a military program. But at the same time, he does not think we should gratuitously provide any potential enemy with valuable information about any difficulties which may be encountered in the development of new weapons systems."

Apollo Contract Due in January If Budget Increase Is Approved

Washington—Prime contract for the detailed design and fabrication of the three-man Project Apollo spacecraft will be awarded in January if the National Aeronautics and Space Administration receives the full $79.7 million it has requested to accelerate the program.

NASA is preparing Apollo specifications for the design phase on the basis of three feasibility studies conducted by the industry and on information developed by the agency's research centers.

Apollo proposals will be requested this summer and, under the present plan, will be submitted in September.

Extent of the Apollo contract is related directly to Fiscal 1962 funding. Budget Bureau under both the Eisenhower and Kennedy Administrations has approved only $29.5 million, which would hold the contract to a design phase in the coming year. House space committee on May 5 restored the full amount requested (AW May 8, p. 27), which would permit a hardware contract this year.

The Apollo study contractors each spent a day last week at Langley Research Center making oral reports on their recommendations. General Electric Missile and Space Vehicle Department reported May 15, Martin Co. on May 16, and General Dynamics/Astronautics May 17. These companies were awarded $250,000 feasibility study contracts last November, essentially to define the best means of achieving multiman earth and moon-orbiting missions. Hardware contract will be open to all qualified bidders.

The specifications also will take into account NASA's in-house research information, particularly in the areas of structures and materials.

Apollo development program will depend heavily on information obtained from Project Mercury manned orbital flights and extended biomedical orbital missions in the Mercury capsule. The last six Mercury capsules will be fitted to carry a chimpanzee and two rhesus monkeys on earth-orbital flights lasting up to 14 days to determine the effects of long-term weightlessness and to evaluate Apollo components.

Apollo flight test program will not be initiated until Fiscal 1963 and will use Little Joe, possibly an advanced Little Joe, Atlas, Atlas Agena B and Saturn launch vehicles. Background data on re-entry dynamics is to be obtained from Scout payloads, which could be flown this year (AW Apr. 3, p. 52).

Advanced Little Joe is now under consideration by NASA and would consist of a seven-Algol booster clustered into a 14-ft. diameter airframe to accommodate the proposed Apollo heat shield section.

NASA has ordered two standard Little Joe vehicles, presumably for small scale model aerodynamic tests of Apollo. Standard vehicle is a cluster of four Castor and four Recruit solid propellant motors, which ignite as a single stage to produce about 350,000 lb. of thrust, simulating the liftoff thrust of the Atlas. It weighs 40,000 lb., stands 25 ft. high and is 6.5 ft. in diameter.

The advanced Little Joe under consideration would be based on the Aerojet Algol solid fuel rocket which is now used as the Scout first stage. Cluster of seven as a single stage could produce 721,000 lb. thrust, which could be increased by adding Recruit assist rockets. This vehicle would weigh about 170,000 lb. and be 31 ft. high.

NASA says the basic Apollo design consideration is the 25,000 mph. reentry velocity which would occur during return from a flight to the vicinity of the moon. In addition to the re-entry vehicle, essential development needs are an environmental control system to provide a livable atmosphere for a three-man crew for several weeks, pilot displays, attitude control, power supplies, communications systems and spacecraft propulsion.

About half the total vehicle weight is expected to be in the propulsion system, which will be used for escape and maneuvering. Orbiting laboratory will weigh about 15,000 lb., and lunar mission spacecraft about 20,000 lb.

NASA will manage the Apollo contract through the Space Task Group at Langley, which is directed by Robert R. Gilruth. Project team, which consists of about 70 engineers, is headed by M. A. Faget and R. O. Piland.

The agency requested $2.6 million to add 300 persons to the Space Task Group Apollo staff, $72.1 million for research and development, and $5 million for a tracking station. Formally approved budget was $29.5 million, all for research and development.

Full funding would permit first earth orbital flight in about four years, and a circumlunar mission by 1967. The lower funding level would slow the program by about a year.

Apollo concept was first described in detail last summer (AW Aug. 29, p. 26) when Gilruth said its future will be dictated by manpower, money and technical progress.

In its feasibility study, Martin recommended radiation protection be obtained by flying a polar trajectory to avoid the trapped radiation of the Van Allen belts. Concept of a storm cellar to protect against solar flare radiation was scrapped when it was found that a properly designed vehicle can provide adequate protection, Martin said.

Martin Apollo Program Manager Carlos de Moraes said the space vehicle surface was divided into 500 sections, and each was assessed for its shielding capability. Weak sections were reinforced by placement of interior components and by spot shielding.

Storm cellar approach would have doubled the vehicle weight, de Moraes said.

Charyk Warns Against Unsound Proposals

Washington—Dramatic presentations to the military services of concepts that are technically unsound or highly speculative but are claimed to be attainable at an early date and at low cost have been criticized by Air Force Under Secretary Dr. Joseph V. Charyk.

"I see too much of attempts to solve problems by the massive application of manpower rather than by the selected application of brainpower," he told a group honoring Dr. Theodore von Karman, aeronautical pioneer, on his 80th birthday.

"Sometimes accomplishment seems to be measured by the size of the contracts required to complete the job rather than by the efficiency with which the job was executed," he added. "We tend to substitute glossy proposals for sound technical ideas and we oftentimes confuse technical concepts with demonstration models. I believe we have become too enamored of sophistication and too deprecative of simplicity," he said.

Dr. Charyk observed that the science of aeronautics "has fostered concepts of national and international policy which were virtually beyond the imagination of people" half a century ago. "The ideological conflict in which we find ourselves engaged is an anachronism in relation to the state of the development within the aeronautical sciences.

"This has made it necessary to alter the classical method of waging such a conflict, and we can expect the struggle to sway back and forth until political diplomacy and aeronautical technology have been made to complement each other at the highest political-scientific plane," he said.

Commenting on the impact of aeronautical advances on political, economic and military affairs, Dr. Charyk said: "Since this is the type of world in which we live today, the scientist can no longer escape to an ivory tower or pretend that these affairs are not his business."

Flickinger Warns of Soviet Space Threat

By Edward H. Kolcum

Washington—Soviet lead in life sciences could soon deny the use of space to U. S. vehicles, but this country has not yet recognized this military threat, according to Brig. Gen. Don Flickinger, Air Force Systems Command assistant for bioastronautics.

Gen. Flickinger told a House space subcommittee that the orbital flight of Yuri Gagarin—with its advanced environmental and life support systems—cannot be duplicated by the U. S. for 3½-4 yr. (AW May 15, p. 34). He indicated that the Air Force biosatellite program does not have the strong backing of the Pentagon. His testimony was released last week.

Gen. Flickinger, testifying before a special life sciences subcommittee on the National Aeronautics and Space Administration's Fiscal 1962 appropriations, praised NASA's bioastronautics flight plans, but he warned that NASA is concentrating its effort on non-military aspects and the country is not exploiting the military skills and capabilities in this area.

Instead of a single, consolidated bioastronautics program, he urged dual civilian and military programs to exploit all the U. S. capability, an approach which, although expensive, "may be cheapest in the long run."

Dr. Hugh L. Dryden, deputy NASA administrator, asked Flickinger during the hearings if he and other military aerospace medical specialists are "unable to convince your bosses in the Department of Defense to do what you want done?"

Gen. Flickinger replied that he does "not feel at the present time that we have established the threat or the challenge [of Russia's lead in bioastronautics], and I do not feel that we have mobilized or put into proper management concepts the total resources we have to prosecute an all-out program in manned space flight technology."

Although the Discoverer biosatellite program was not discussed during the hearings, it is one area which Air Force medical specialists say is indicative of the low priority of the military bioastronautics effort. Primate flights have been planned several years, and the first flight was scheduled last fall. But no Discoverer primate flights have been made.

General Electric has delivered capsules designed to carry monkey payloads, and Lockheed has designed a biocapsule to carry the largest primate that can be trained—probably a chimpanzee.

Cause for the delay has been explained at various times as: the requirement to test Midas and Samos components as highest priority Discoverer payloads; an Eisenhower decision to avoid any military association with animal research; the unsettled decision on the extent of the division of responsibilities between NASA and Defense Department, and a refusal by NASA to support military animal space experiments.

NASA has continuously denied blocking the program, or contributing to its delay.

Rep. Olin Teague (D.-Tex.), who headed the special subcommittee, asked Gen. Flickinger if there is specific evidence that U. S. is not exploiting its full skills in the life sciences. Illustrating the political sensitivity of the bioastronautics issue, Flickinger responded: "How can I avoid getting into trouble?"

Rep. Teague also questioned the ability of military aerospace medical officials "to convince people higher up to put sufficient money" in the program, and Rep. Emilio Q. Daddario (D.-Conn.), a frequent critic of the scope of NASA's life sciences plans, asked if the basic problem is not a failure to "spell out a military role for man in space."

Gen. Flickinger said he believes this is true, but he emphasized he is "not at the policy level" and does not know the economics of parallel civilian and military programs.

He expressed shock at Soviet bioastronautics progress, and said this superior technology may "deny space to any of our vehicles, either manned or unmanned, in the relatively near future."

Gen. Flickinger lauded the framework of NASA's life sciences program, particularly the flight plans and the solid backing the program has in academic sciences. He said there is general agreement that NASA needs time to build an internal competence, but this time lag has impeded the capability built up in the services over a long period.

Asked by Rep. Daddario if NASA's biological flight plans can cut into those of the Defense Department, Flickinger said: "No. They represent as much of the budget as [NASA] can commit. But the services have a greater responsibility and an extra good capability to do this type of technology."

Gen. Flickinger said the Aeronautics and Astronautics Coordination Board's life sciences advisory committee is an effective means of determining the division of responsibilities between NASA and the military.

Dr. Dryden said if the advisory committee is unable to agree, the problem comes to him and to Dr. Harold Brown, Defense director of research and engineering. If it remains unresolved, the problem goes to James E. Webb, NASA administrator, and Defense Secretary Robert McNamara. Final authority lies with the President.

Total bioastronautics research effort in the U. S. for Fiscal 1961 is estimated at $11.1 million, $6.1 million spent by the Defense Department and the remainder by NASA. Fiscal 1962 budget requests total $12.6 million, of which NASA has asked $8.6 million.

Justifying its program, NASA requested funds for:

- **Physiologic base line studies** in stress endurance, acceleration, vibration and temperature control, spinning and tumbling, weightlessness and ballistocardiography, or human heart action in a zero gravity.
- **Life support systems** experiments using photosynthetic gas exchanges, water recovery, superoxide, water electrolysis and man-machine integration.
- **Sensors for remote control,** visual feedback, safety and protection and flight preparation.
- **Space biology,** including advanced nuclear emulsion recovery vehicle (Nerv) experiments, and methods to determine extra-terrestrial life in planetary spacecraft.

Equipment designed—but not built, miniaturized or made rugged—includes a Lederberg multivator, which can hold 12 different bacteria cultures, a Vishniac wolf trap to count carbon 14; a videcon microscope and gas chromatograph.

Report on MR-3 Flight

Washington—Results of the major U. S. bioastronautics experiment so far—the Redstone-boosted ballistic flight of Cdr. Alan B. Shepard—will be discussed at an open scientific meeting here next month.

James E. Webb, National Aeronautics and Space Administration chief, said Shepard and Project Mercury aerospace medical specialists will "bring the scientific community abreast of developments" of the Mercury-Redstone flight. The session, to be held at the National Academy of Sciences or the new State Department auditorium, will be open to U. S. and foreign scientists.

Webb said the life sciences meeting is the first of several planned as an open forum. The second, tentatively set for late summer or early fall, will be on weather satellites.

Satellite Needs Push Reconnaissance Gains

Dayton—Significant advances in aerial reconnaissance techniques can be expected in the next decade, but even these will be hard pressed to meet the needs of reconnaissance satellites, Air Force Col. W. S. Heavner predicted here during the National Aerospace Electronics Conference (Naecon).

Col. Heavner, chief of the Air Force Aeronautical Systems Division's Reconnaissance Laboratory here, described the present status and expected gains in aerospace reconnaissance technology during a Naecon panel session.

Optical glass and mirrors for photo reconnaissance of terrestrial objects from space are a "critical problem," Col. Heavner said. To achieve ground resolutions of less than 5 ft. from an altitude of about 200 mi. requires a wide aperture optical system with a diameter of about 30 in. "But our present-day capability, yet to be proved operationally, is around 18 in. diameter, near diffraction-limited systems," he said. For larger lenses, the only source of supply for the U. S. is Germany.

Future Lens Capability

By 1965-70, with sufficient government support, the U. S. could be in a position to produce high-quality refractive lens elements with diameters of 30 to 50 in., Col. Heavner predicted. Lightweight materials suitable for producing collector mirrors with diameters of 100 in. also could be available in the same time period.

To illustrate the weight problem involved in high-resolution satellite reconnaissance, Col. Heavner said that the optics and optical structure required to obtain 5 ft. resolution from an altitude of 200 mi. would weigh approximately 2,000 lb., and that the remainder of the photo-recon payload might weigh an additional 1,000 lb. or more, depending on its film capacity.

New Photo Materials

By 1965-70, new types of photo-emulsion materials which are more resistant to radiation are expected to be available. Representative of such materials are vacuum evaporated coating of monomolecular silver bromide and single crystal silver bromide. By 1965, these materials are expected to provide resolutions of 200 to 300 lines per millimeter at ASA speeds between 10 and 25.

Recent developments in electro-optical recording, such as General Electric's thermo-plastic recording technique (AW Jan. 18, 1960, p. 87) and the Radio Corp. of America's electrostatic tape recorder (AW Nov. 14, p. 68), offer promising alternatives to recording on photographic film, Col. Heavner said.

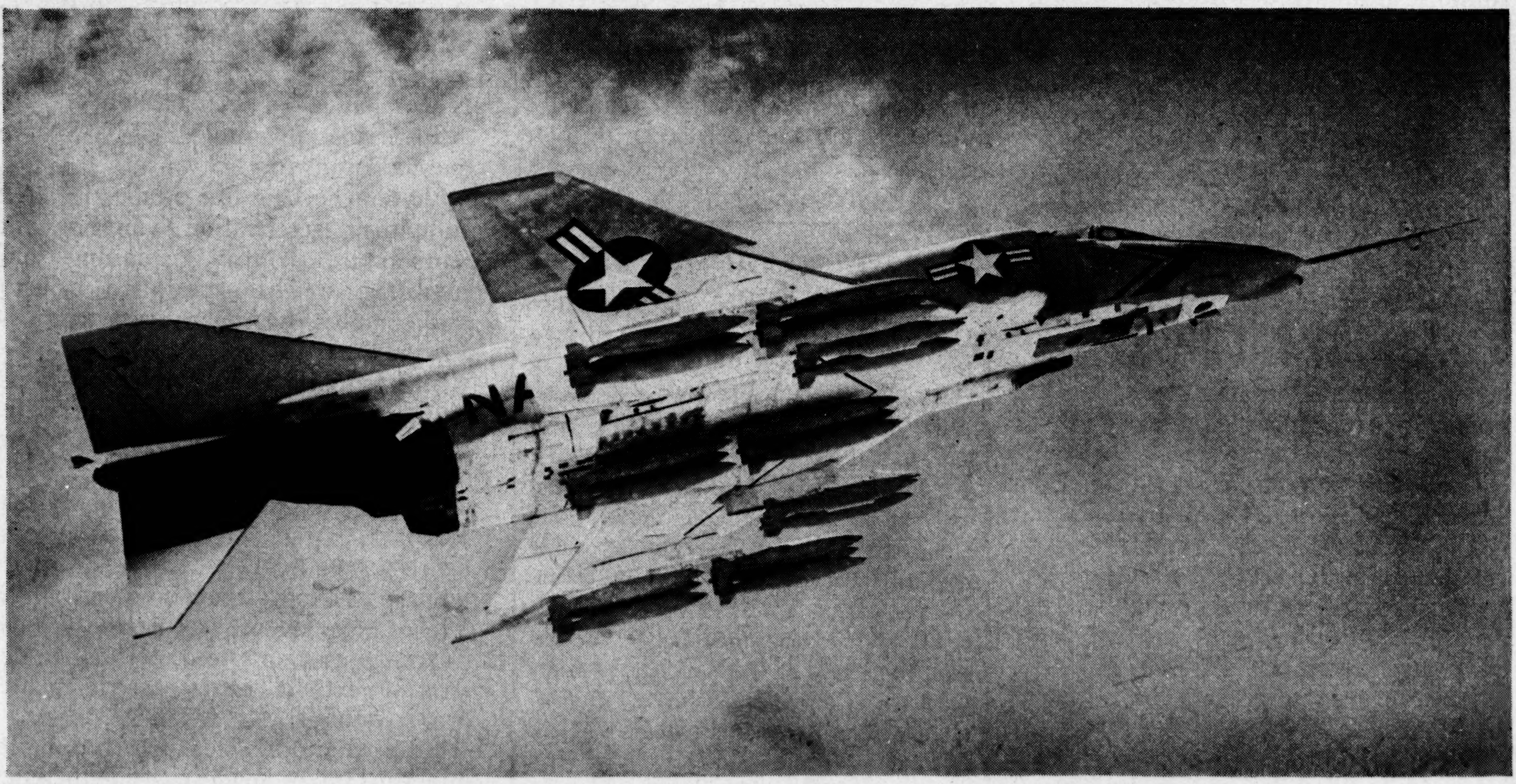
The RCA electrostatic photo-tape requires no chemical processing, it is reusable and its stored image can be read out electronically and telemetered to earth. Although the tape itself has a resolution of about 1,200 lines/mm., the resolution now obtainable is limited to 40 lines/mm. over a 2.25 in. square format because of limitations in the readout electron beam.

Within the near future, the obtainable resolution is expected to increase to more than 100 lines/mm., and multiple reading guns should permit use of a larger storage area.

The GE thermo-plastic recording technique, which offers many of the same advantages for reconnaissance satellites, now provides the equivalent of an ASA speed of 10 and a resolution of 40 lines/mm. with eight shades of gray. By 1965-70, new photo-sensitive materials, expected to eliminate the process now required to transfer charge within the tape, should give an ASA speed of about 100, with a resolution of 100 lines/mm. and 15 shades of gray, Col. Heavner said.

Television Capability

Presently available television cameras can provide 1,500 x 1,500 picture elements in a 2 x 2 in. format, giving 25 times better resolution than home television. With a 24-in. diameter optics system, a 10-ft. focal length and a map interval of one mile, this gives a resolution of 15 ft. at a 300-mi. altitude, Col. Heavner said.



McDonnell F4H-1F Designed for Ground Attack Missions

McDonnell F4H-1F, modification of eleventh production airplane for ground-attack missions with conventional weapons, is shown carrying 22 clustered 500-lb. bombs. Developed as two-place interceptor powered by paired General Electric J79 afterburning turbojets, the F4H-1 also has attack capability with nuclear weapons. McDonnell will propose conventional-weapon version to Navy.

Through the use of fiber-optics to provide multi-stage light amplifiers, Col. Heavner predicted that the sensitivity of TV cameras will be increased sufficiently to provide useful returns from starlight illumination.

Infrared reconnaissance, while useful at any time of day, is more effective at night in total darkness when terrestrial objects do not reflect sunlight. Present equipment has given 100 ft. resolution at an altitude of 40,000 ft. By 1970, he predicted, the infrared systems should be capable of providing 90 ft. resolution at an altitude of 300 mi., using 40 in. diameter optics.

This prediction is based on the assumption that infrared detectors with sensitivity of 10^{-14} watts/sq. cm. can be developed for operation in the 8-14 micron wavelength region. It also is predicated on development of smaller, lightweight detector cooling equipment, capable of operating at a temperature of 4.2K for a year or more.

Col. Heavner predicted that infrared imaging tubes operating in the 8-14 micron region will replace presently used single or multiple-element detectors in the 1965-70 period. But he said that single element cells of advanced design are likely to be used in most reconnaissance equipment for the next three to five years.

Radar Techniques

One of the most promising radar techniques for reconnaissance is the current, side-looking radar which uses vehicle motion to make a small antenna perform like a very long antenna, improving target resolution. An existing side-looking radar provides about 50 ft. range and azimuth resolution at ranges up to 12 mi. One limitation of such radars is imposed by atmospheric attenuation at the higher frequencies employed to give good definition.

Another is the problem of handling and analyzing large amounts of data aboard the vehicle itself.

Despite this, Col. Heavner predicted that by 1970, radar would be able to provide 25 ft. resolution from an altitude of 300 mi. and cover an area 10 mi. square. For longer ranges and higher resolutions, the power requirements are so severe that techniques beyond the use of pulse compression may be required, in addition to the use of multiple beams to provide unambiguous coverage, he said.

Col. Heavner said that optical maser (laser) radars will find a prominent role in reconnaissance because of their inherent high resolution and low power consumption. "We expect laser research to progress at an accelerated rate, with emphasis on achieving higher peak power and more rapid repetition rates," he said. Present indications are that a laser radar can provide resolutions of 5 ft. at orbital altitudes.

Passive microwave reconnaissance, which resembles infrared reconnaissance except that radiation is detected at microwave frequencies, has better all-weather capability than infrared (AW July 1, 1957, p. 62). Man-made objects, particularly metal buildings, stand out quite clearly.

The first successful airborne passive radar, the AN/AAR-24, completed in 1959, has demonstrated the capability of resolving to 35 ft. at 1,000 ft. altitude. Man-made and natural targets have been observed at altitudes up to 18,000 ft., Col. Heavner reported.

The future role of passive microwave reconnaissance depends on development of solid state preamplifiers capable of operating at wavelengths of 2.5 to 3.5 mm., and of large aperture unfurlable or extensible antenna arrays. By 1970, it may be possible to obtain resolutions of about 0.005 of a degree using a 20-ft. linear array.

Ferret Reconnaissance

The detection and location of all sources of electromagnetic radiation from enemy radio/radar stations is an important reconnaissance area. Presently available Ampex airborne tape recorders are capable of recording 4-mc. bandwidth instantaneously on magnetic tape.

In the future, the Air Force expects to have fully automatic electromagnetic reconnaissance systems, for both aircraft and space vehicles, which do not require the presence of a human operator.

The systems will be designed to store and analyze complex and unusual signals, comparing them with previously detected or known signals to sort out new signal sources.

Processing of communications signals will be made on the basis of type of modulation, linguistics and semantic characteristics, Col. Heavner predicted. The capability to intercept and analyze signals in the extremely high frequency (EHF) band to beyond 300 kmc. will be extended, he said.

Correlation of Data

Correlation of reconnaissance images obtained from a variety of sensors (optical, infrared, radar, etc.) poses a challenging problem. The present trend is to use side-by-side visual displays for each of the sensors, with the human observer attempting to locate targets by comparison.

Automatic target recognition is a long-term research goal, but no practical approach has been uncovered to date, Col. Heavner said. But by 1965, he predicted that reasonably good man-correlation of gross targets can be expected, and some crude machine-correlation techniques should be available (AW Apr. 24, p. 67).

RCA Wins Relay Satellite Award

Washington—Radio Corp. of America was given a $3,250,000 contract last week to develop the Relay active repeater communications satellite, beginning a program that is expected to result in components for the U. S. commercial communications satellite system.

Seven proposals from companies and teams have been under consideration since Mar. 27 by a National Aeronautics and Space Administration source selection board at Goddard Space Flight Center (AW Mar. 27, p. 25). The board's recommendations went to NASA headquarters last week. First Relay flight could be made in a year.

NASA is expected to select the locations and types of ground stations for both active and passive communications satellites shortly. England and France already are building ground stations for both types of satellites.

Passive Communications

In the passive communications program, NASA last week decided to eliminate the use of Atlas-Centaur launchers in the Rebound development series and to use the Atlas-Agena B exclusively for this program. Rebound is a 135-ft. diameter, 500-lb. sphere considerably more rigid than Echo, which is now in orbit.

Atlas-Agena B can carry a three-sphere payload into orbit, and Centaur would have had a six-sphere capability. Centaur, however, will not be available for the Rebound program until 1964, a year later than Atlas-Agena B, so NASA elected to make the change.

Preceding the Rebound launches will be ejection-inflation tests in which single Rebound spheres will be boosted into ballistic trajectories 700-800 mi. high and 650 mi. in range. This program, called Echo II, will use two Thor boosters launched from the Atlantic Missile Range.

Final part of the Echo II program is an orbital test next spring of a single 135-ft. sphere from Pacific Missile Range. Thor-Agena B will be used to place the sphere into a 700-mi. circular polar orbit.

The Relay development program will use Delta launch vehicles for component tests and Atlas-Agena B vehicles for complete spacecraft flights. Contract will call for delivery of four identical satellite units—two for flight, one prototype and one a spare.

Aerospace Companies' Role Stirs Commercial Satellite Controversy

By Philip J. Klass

Washington—Question of whether aerospace companies should be partners in, or merely suppliers for, a commercial communication satellite system became one of the major issues last week in the controversy over how the U.S. should proceed with the implementation of such a system.

Developments included:

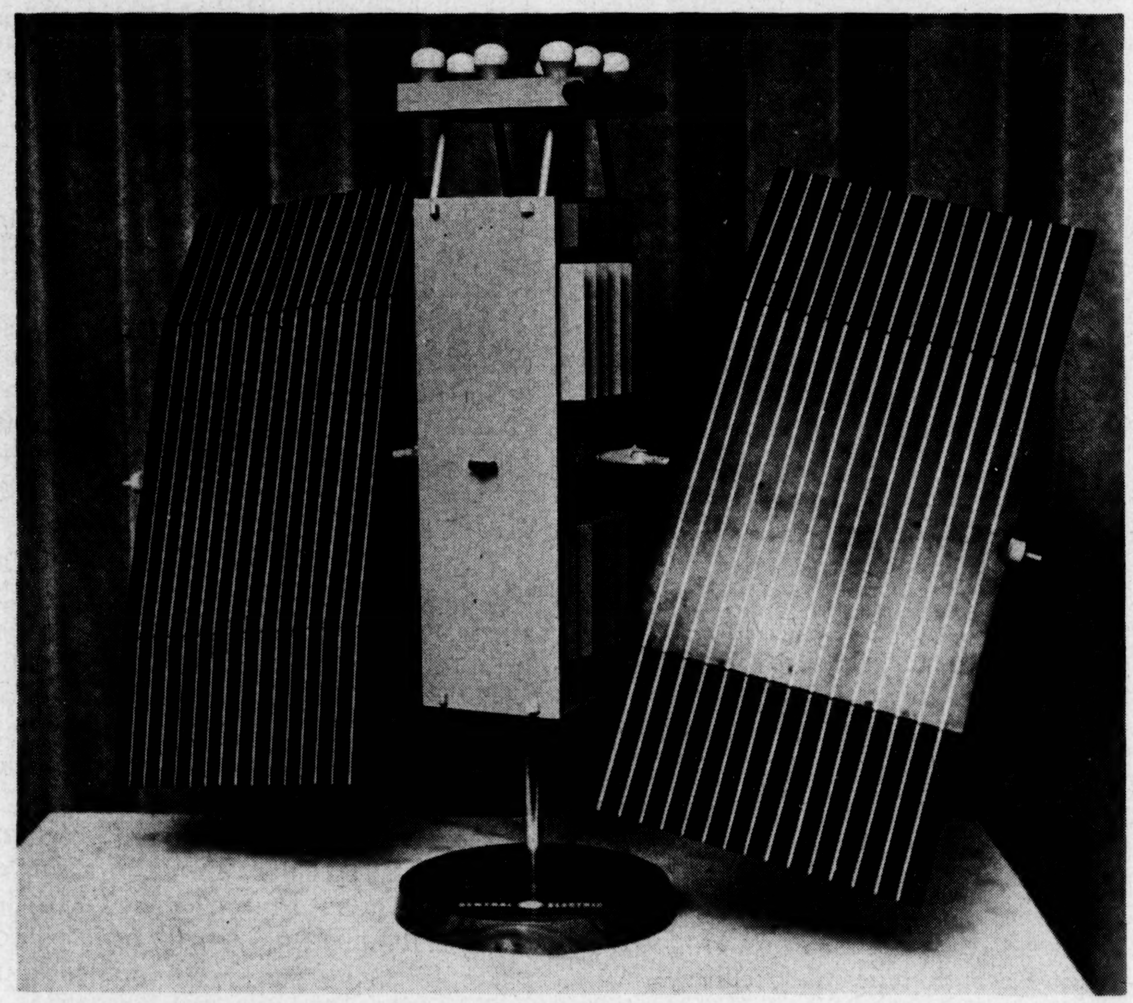
- **American Telephone & Telegraph Co.**, in a statement filed last week with the Federal Communications Commission, said that admission of aerospace firms as part owners of a space communication system would be "both undesirable and unworkable." This was one of four prerequisites set forth by the Justice Department in its recent statement to the FCC (AW May 15, p. 25).
- **Lockheed Aircraft**, which was the first to propose a joint-venture space communications satellite system (AW Mar. 20, p. 28), advised the FCC that it was willing to bow out of part ownership if communication common carriers were willing to finance the project themselves, as they indicated in their May 1 comments to the FCC.

Lockheed's action was prompted by comments of the carriers to the FCC expressing strong opposition to sharing system ownership with non-carriers (AW May 8, p. 34). Lockheed recommended that the FCC encourage all U.S. international common carriers to get together and prepare a concrete proposal for the business structure and operational plan for a space communication system company.

If the carriers are unable or unwilling to settle their remaining differences, then other private interests such as Lockheed, which have shown a readiness to proceed, should be given the opportunity to do so, Lockheed said. Lockheed emphasized that it is interested in providing satellite system planning, design, engineering and operational services.

- **General Electric**, following recent discussions with the Justice Department, held its first discussions with a communications common carrier that had approached GE following the formation of its new Communication Satellites, Inc. The new company is intended as a focal point for a joint-venture space communication system.

AT&T's latest comments to the FCC also appear to be intended to win over smaller carriers, which have expressed fear of an AT&T-dominated space system, by capitalizing on their opposition to a system partially owned by outsiders.



COMMERCIAL COMMUNICATION SATELLITE proposed by General Electric (AW May 8, p. 34) would weigh about 1,000 lb. and have body dimensions of 88 x 26 x 33 in. Each of 10 satellites in 6,000-mi.-high equatorial (non-synchronous) orbits would contain four radio repeater packages, each capable of handling 300 voice channels, one radio repeater for relaying 6-mc. television signal and two additional repeaters for servicing low-capacity stations. Infrared horizon sensors would be used for attitude stabilization. Solar cells and nickel-cadmium batteries would supply 700 watts of power required.

Responsibility Factor

AT&T said formation of a new entity to own and operate the satellite system, such as that proposed by GE and Lockheed, would "enable satellite hardware suppliers, who have no responsibility to the public for the quality or scope of service, to participate in management and operation of a common carrier undertaking . . . this would seriously dilute the carriers' ability to discharge their responsibility to render service of the highest quality since a fundamental link in the communications network would have been placed outside the control of the carriers responsible . . ."

Formation of such an intermediate "carriers' carrier" is unprecedented and has never been found necessary or desirable in working out cooperative arrangements for use of such international facilities, the company said.

AT&T also said ownership by aerospace suppliers would introduce new administrative complexities and problems of operational control, and said many of these aerospace firms "would deem it necessary to acquire an interest in the satellite company, particularly if their competitors elected to do so."

The implication is that aerospace firms might seek to participate because they feared it was necessary to assure themselves of an "insider's insight" into subsequent hardware procurements.

A GE spokesman pointed out that many of the communication common carriers themselves are in the aerospace/avionics business. This includes AT&T, Radio Corp. of America, International Telephone & Telegraph Co. and General Telephone and Electronics. Because of this, it would be difficult to justify excluding other aerospace/avionics firms from participation.

System Control

AT&T questions the need for aerospace industry ownership in view of another Justice Department stated requirement that all such companies be given unrestricted opportunity to furnish such equipment—a provision with which the company has no quarrel. The company said its joint ownership plan (AW May 8, p. 34) also meets Justice Dept.'s criteria for assuring all common carriers the opportunity to participate in system ownership and/or to rent facilities on a non-discriminatory basis.

In its comments to the FCC, Justice also stated that the space communication system project is "so important to the national interest that it should not be owned or controlled by a single private organization, irrespective of the extent to which such a system will be subject to government regulation."

In AT&T's most recent comments, it said it believes its proposal "is consistent with the [Justice] Department's objectives," and pointed out that FCC has the power to assure that no single carrier gains a competitive advantage over others.

In response to an AVIATION WEEK query, Justice said the question of whether the system was "controlled" by a single company would depend upon the detailed arrangements of the plan under which it was owned and operated. The amount of ownership held by one company, and the distribution of the balance, are influential factors. Under some circumstances a holding of less than 25% by a single company has been viewed as giving it control.

Justice Dept. said it is not likely to render such an opinion on the communication satellite program until a specific plan is submitted to it by the FCC or the President.

Schriever Predicts Long Future For USAF Non-Profit Corporations

Washington—Long-range future for nonprofit corporations acting as technical advisers and planners for the Air Force is foreseen by Lt. Gen. Bernard A. Schriever, commander of the new Air Force Systems Command.

Briefing industry representatives on the new AFSC organization, Gen. Schriever commented that private companies could not perform these advisory functions objectively because of the profit motive. He said that since the Air Force has not been able to achieve an in-house capability in planning, it has to use the service of a company such as Aerospace Corp. (See p. 80.)

Commenting on questions concerning Aerospace Corp.'s ability to gain technical competence in a short time with a "panic" growth rate, Gen. Schriever said the company, which reports to AFSC's Space Systems Division, has been able to obtain a top level management staff. Aerospace first transferred 300 persons from STL and has since hired 200 more. He said he didn't consider this a panic growth rate.

To establish better relations with industry Gen. Schriever said he will create a board or group to maintain constant liaison. He emphasized that one of the major drawbacks to orderly conduct of business for the Systems Command and its predecessor, the Air Research and Development Command, has been heavy industry visitor traffic at headquarters offices on matters dealing with details of the development of systems.

These details, he said, are no longer known at headquarters. Contact should be made with system program directors. Problems not solved at this level should then go to the division commander. Beyond that, in the case of the Space and Ballistic Systems Divisions in California, the deputy commander is to resolve problems, while Gen. Schriever will resolve questions arising in other divisions.

Maj. Gen. Howell M. Estes, deputy for aerospace systems, has the authority to act in Gen. Schriever's name and to go directly to the Pentagon for guidance on various problems. Gen. Schriever reports to the Air Force Chief of Staff.

Gen. Schriever also said that:

- **Systems management of the booster** for the Dyna-Soar orbital boost-glide vehicle will remain at the Space Systems Division, while the vehicle itself will remain under the Aeronautical Systems Division in Dayton, Ohio.
- **Manned systems will remain** at ASD. Considerable agitation was evident recently in the Ohio congressional delegation and the press concerning transfer of such projects to the West Coast.
- **Since there is no clear** line between development and operation in newer weapon systems, assembly line production will be unlikely. The Minuteman ICBM will have limited line production, while space systems probably will never approach line production.
- **Division overlaps in programs** have been solved in many instances by having the personnel located together physically. He gave the re-entry vehicle project offices as an example.
- **Air Force plant** representatives will now report to the Systems Command through the Contract Management Regions.
- **Fiscal 1962 budgeting** will emphasize a package approach where a system will be funded as a complete unit. Exceptions will be low priority and new systems.
- **Air Force will continue** to ask for cost sharing in research and development.

Dyna-Soar Awards

Boeing Co. has awarded the following subcontracts under the Air Force's Dyna-Soar space glider program:

- **Multi-million-dollar contract to Thiokol's Elkton, Md., division, for a solid-fuel acceleration rocket which will provide additional boost to the glider after the Titan booster's second stage burns out. The unit also will serve as an escape rocket to propel both glider and pilot free of the booster if an emergency occurs during launch. Thiokol will design, develop, test and manufacture the acceleration rocket, which will include thrust vectoring, to meet Dyna-Soar's Phase I development schedule.**
- **Contract exceeding $1 million to Westinghouse Electric Corp.'s Aerospace Electrical Department, Lima, Ohio, for development of a control unit which will be the source of the glider's electrical power, consisting of a 400-cycle three-phase brushless generator, including voltage regulator, control panel, circuit breakers and current transformers.**
- **Multi-million-dollar contract to Electro-Mechanical Research, Inc., Sarasota, Fla., for airborne equipment for collecting and preparing Dyna-Soar test data and ground equipment for receiving, displaying, recording and processing the data. Equipment will include pulse code modulated and frequency modulated conversion equipment, a time-coded generator and a tape recorder for data storage.**
- **Contract for $45,000 to Goodyear Tire & Rubber Co., Akron, Ohio, to develop main landing gear skids. A wire brush arrangement will bring the boost-glide Dyna-Soar vehicle to a stop by creating friction on landing.**

Bell, Hiller Chosen To Design Army LOH

Washington—Army has chosen Bell Helicopter Co. and Hiller Aircraft Corp. to design competitive light observation helicopters.

Seeking a replacement for its smaller fixed-wing aircraft and its older helicopters for battlefield work, the Army specified a four-place, turbine-powered vehicle in the 250-hp. class. As the specifications were written, it would have been difficult for a designer to choose any other engine than the Allison T63.

The separate Bell and Hiller LOH designs will be started through a development cycle. When it becomes clear that one design is favored, its development will be completed and production begun.

Over a five-year period, the Army is expected to purchase more than 2,000 of these aircraft, and the ultimate inventory goal is 3,500.

Saturn, AMR Proposed for Tests Of First Nuclear Rocket Engine

Washington—Four study contractors have made independent recommendations that Nerva, the first nuclear rocket engine, be flown from existing Atlantic Missile Range facilities as the second or third stage of a Saturn booster.

Development contract for the Nerva engine is under consideration by a joint Atomic Energy Commission-National Aeronautics and Space Administration source selection board and a contractor is expected to be chosen within the next several weeks (AW Apr. 10, p. 33). Leading contenders are believed to be Aerojet-General Corp., North American Aviation's Rocketdyne Division and Thiokol Chemical Corp.

Lockheed Aircraft Co., Martin Co., General Dynamics/Astronautics and Douglas Aircraft Co. all concluded independently that radiation safety will not be a problem in test flying the Nerva engine. The conclusion was among requirements of a nuclear rocket flight test program reported in the reactor inflight test system (Rifts) studies being evaluated by NASA. The agency sponsored Lockheed and Martin studies, and the others were unfunded.

Harold B. Finger, chief of the AEC-NASA Nuclear Propulsion Office, told Aviation Week one Rifts study recommended the engine be flown as the second stage of the Saturn S-1, and the other three suggest the S-1 and S-2 stage be used to boost the nuclear system. All recommended that the first flight be a ballistic lob, but none believe it necessary to launch from off-shore or Florida Everglades facilities.

Finger said that if off-shore facilities are available, they could be used, but the test flight will not require them.

Seven companies submitted proposals for the Nerva contract, and Finger said the current plan is to choose one of them for these major contract tasks:

- **Design the facility** for engine and vehicle development.
- **Provide technical support** to the Los Alamos Scientific Laboratory for Kiwi B tests.
- **Design the Nerva engine** and define the development test program.
- **Conduct research and development** in critical engine component areas.

The Nuclear Propulsion Office is now establishing three field offices to support the Rover development program, Finger said. Management of the engine system will come under an office to be located in Cleveland, Ohio, near Lewis Research Center; a reactor office will be established in Los Alamos, N. M., and the flight test system project office will be at the Marshall Space Flight Center in Huntsville, Ala.

The Nuclear Propulsion Office continues to favor the AEC Nevada test site at Jackass Flats as the Rover test site and is seeking $15 million in Fiscal 1962, to build a test stand for the engine and reactor. Before the system can be fully tested, however, a complete vehicle test stand will be necessary.

Total development cost of the Rover operational engine has been estimated at $1 billion, and the Nerva prototype engine development program will result in expenditures of several hundred million dollars over the next 6½ yr.

Kiwi B tests, now scheduled for August, will use a downward firing engine with the nozzle cooled by liquid hydrogen, which also is used as the working fluid.

The Kiwi A series used hydrogen gas as a working fluid and had a water cooled nozzle.

Rocketdyne has developed a flightweight nickel alloy nozzle for the Kiwi B tests. The company, which built nozzles for the upward firing Kiwi A test engines, also has a contract for Kiwi B axial flow turbopumps and a throttleable feed system.

The axial flow turbopump consists of a turbine adapted from the Atlas engine, with a power control valve to control gas flow rate driving the propellant. Turbine speed can be varied from 1,000-25,000 rpm., Rocketdyne said.

Price Protests ANP Cancellation

Washington—Rep. Melvin Price (D.-Ill.) last week protested cancellation of the Aircraft Nuclear Propulsion program, contending a nuclear-powered airplane not only would be "militarily useful" but represents "the most logical step before us today in the development of aerial transportation."

Rep. Price—chairman of the Joint Atomic Energy Research, Development and Radiation Subcommittee—took issue in a House speech with the recent contention of Defense Secretary Robert S. McNamara that a nuclear airplane would have little or no military value (AW May 8, p. 20).

Rep. Price listed 11 military uses for a nuclear aircraft, including strategic bomber, missile launcher, airborne command post, cargo or troop carrier, weather station and early warning aircraft.

Charging that Defense Department specifications were being met in the ANP program, Price said, "therefore if there were any complaints to be made concerning the value of the nuclear aircraft, they should have been addressed to Mr. McNamara's organization, the Department of Defense, who set down the specifications.

"The chaos is evident in the history of the program itself, which has been characterized by indecision on the one hand and faulty decision on the other on the part of the Department of Defense. This inconsistent state of affairs has resulted in a tremendous waste in time, money and manpower and has earned only contempt for those who have suffered under the aegis of dilatory Defense Department domination," Price said.

Citing McNamara's interest in manned systems to operate when both sides have large intercontinental ballistic missile forces, Rep. Price said: "What could satisfy this requirement better than the [nuclear] aircraft right under his very nose?"

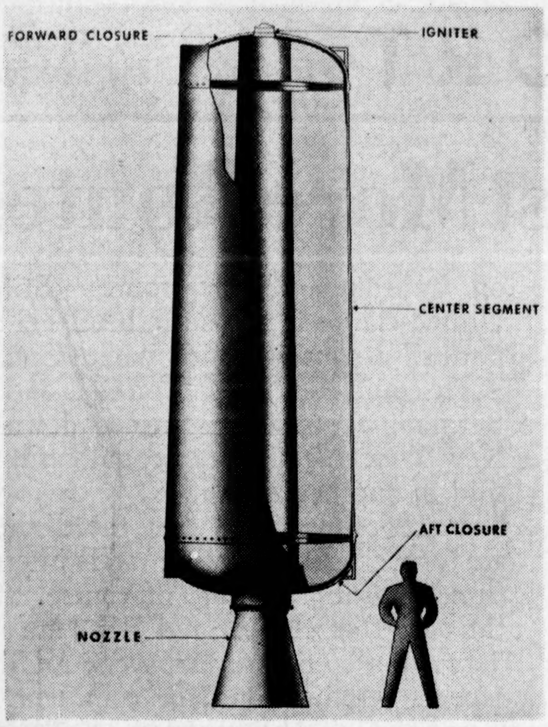
Rep. Price countered claims that a nuclear airplane would be "too heavy and too radioactive," asserting it would be no heavier than the heaviest current military aircraft and that dangers to the crew or population below from radioactivity would be negligible.

He noted the unlimited range, high payload capacity and the independence a nuclear airplane promises, and said: "the manned nuclear aircraft should not be looked upon as a scientific freak or stunt, as some are prone to do. Rather it should be judged for what it is, the most logical step before us today in the development of aerial transportation." He said the "defense of our country, as well as that of free people everywhere, would be seriously affected" if Russia developed the first nuclear airplane.

Tory IIA-1 Tested At 27% of Full Power

Las Vegas, Nev.—Tory IIA-1 nuclear reactor designed to test the feasibility of a reactor core in nuclear ramjet Project Pluto was successfully operated at 27% of full power in a 45-sec. run at the Atomic Energy Commission Nevada test site.

Operating temperatures during the brief test of reactor behavior exceeded 2,000F. Power output during the test was approximately 40 thermal megawatts, the level planned before the test. Full design power of the Tory IIA-1 reactor is 150 thermal megawatts. Future tests will be made at progressively higher power and temperature levels until full design power is reached.



UNITED TECHNOLOGY CORP. solid booster, to be static-tested in July, is 317 in. long and 78 in. in diameter. Booster weighs 75,020 lb. and is designed to generate 259,000 lb. thrust.

UTC Firings Called Key to Large Solids

Washington—Conical solid rocket, weighing 75,020 lb. and developing 259,000 lb. thrust, will be static fired in July by United Technology Corp. in a large solid booster development program funded jointly by the company and National Aeronautics and Space Administration.

The negotiated contract, signed early this month, calls for ground demonstration firings of two such motors. NASA portion of the funding totals $1.8 million, with money coming from both Fiscal 1961 and Fiscal 1962 budgets. The project is the first step NASA has taken in large solid rocket hardware.

The program follows an earlier United Technology-NASA contract under which three 15,000-lb. thrust conical segmented motors were successfully test fired (AW Apr. 10, p. 56). William Cohen, NASA solid rocket programs chief, told Aviation Week the coming tests should "answer 95% of the basic questions on large size" in solids.

The United Technology booster, 317 in. long with 78 in. diameter, contains 66,510 lb. of propellant. It is designed to burn 60 sec. with a specific impulse of 245 sec. The nozzle is 51 in. long and has a 29-in. diameter.

Booster is composed of three pieces with a pyrogen igniter at the top of the 3,916-lb. head piece. The main segment weighs 57,683 lb., and the aft closure section, 4,911 lb. The propellant is packed in a case of No. 11 case hardened steel made by Pratt & Whitney Aircraft Division of United Aircraft Corp., United Technology's parent company.

Motor pieces are joined by a special clevis and pin developed by United Technology and Pratt & Whitney.

The company's large solid booster program was outlined to Congress in March during a special series of hearings on space propulsion technology (AW Mar. 20, p. 50).

Record Runs Planned By Air Force, Navy

Washington—Air Force and Navy will attempt to set a variety of aircraft and helicopter records this week.

Four McDonnell F4H-1 fighters will compete for the Bendix Trophy, racing from the Los Angeles International Airport to Floyd Bennett Naval Air Station, New York. Another F4H will attempt the speed record for 3 km. at an altitude restricted to 100 meters (328 ft., 1 in.) near Albuquerque.

Air Force plans to try for the helicopter altitude record, carrying a 1,000-kilogram payload with a Kaman H-43B. There will also be a try at the long-distance non-refueled record with a Boeing B-52G flying from Yakota, Japan, to Torrejon, Spain, via Oklahoma City. Previous attempt was canceled when B-52G wing spar troubles called for imposition of takeoff weight limits.

An Air Force General Dynamics/Fort Worth B-58 bomber will try for speed records from Los Angeles to Washington, Washington to New York and New York to Paris in conjunction with the Paris Air Show.

In the Bendix race, the aircraft will be air refueled near Albuquerque, St. Louis and Pittsburgh by 12 Douglas A3D bombers which can be converted to aerial tankers. The F4Hs will fly supersonically at 50,000 ft. except when refueling.

HSS-2 Speed Record

U. S. Navy twin-turbine Sikorsky HSS-2 helicopter claimed a world helicopter speed record of 192.9 mph. last week over a 1.86-mi. straight line course at Bradley Field, Windsor Locks, Conn. Fastest helicopter speed previously recorded was 166.5 mph. flown by a Russian Mi-6 Nov. 21, 1959 over a 62-mi. closed circuit.

The HSS-2, powered by two General Electric T58-8 gas turbine engines rated at 1,250 shp. each, was flown in standard configuration by Cdr. Patrick L. Sullivan and Lt. Beverly W. Witherspoon. The speed run was conducted under the sanction of the National Aeronautics Assn. and is subject to confirmation by Federation Aeronautique Internationale.

News Digest

USAF-Aeronutronic Blue Scout to be launched late in July is scheduled to carry the backup balloon satellite payload from National Aeronautics and Space Administration's successful Explorer IX Scout launch. The 80-lb. package contains a 12-ft. sphere to measure air drag, which USAF plans to put in a 500-mi. circular orbit.

Federal Aviation Agency Administrator Najeeb E. Halaby has canceled Project Straight-Line under which his predecessor, Elwood R. Quesada, planned to establish 22 Field Area Offices (AW Feb. 20, p. 50). The project, scrapped after a six-week study of problems in the Cleveland Air Route Traffic Control Center, would have decentralized administration of the Bureau of Air Traffic Management.

Port of New York Authority has had formal requests from United and American Airlines to operate jets at Newark Airport next month, and the agency has advised Governor Robert Meyner of New Jersey it is considering granting the requests.

Arbitrators in the disagreement between Fairchild Stratos Corp., formerly Fairchild Engine and Airplane Corp., and Umbaugh Aircraft Corp. have found that "Under the circumstances, Fairchild Engine and Airplane Corp. is entitled to refuse further to perform under the contract dated Aug. 9, 1959 between Fairchild and Umbaugh Aircraft Corp. and to regard said contract as no longer of any further force or effect" (AW Apr. 17, p. 34).

Vice Adm. William F. Raborn, Navy director of special projects, will be awarded the Robert J. Collier Trophy June 15 for directing development of the Polaris missile weapon system.

Phillip M. Swatek, 37, chief of the Cincinnati Enquirer's Washington Bureau and a former Navy pilot, has been appointed chief of the Federal Aviation Agency Office of Public Affairs.

USAF-General Dynamics Atlas E made a 5,000-mi. flight over the Atlantic Missile Range May 12 carrying the Avco Mark 5 nose cone, which will be used on the Minuteman (AW May 15, p. 28). Next Minuteman flight is due this week.

Atlantic Research Corp. Arcas Robin sounding rockets were fired in a series of 24 shots at one-hour intervals from Eglin AFB May 9-10 carrying 8.5-lb. weather balloon payloads to altitudes from 16-45 mi.

AIR TRANSPORT

British Independents Request More Routes

Favored positions of BOAC, BEA threatened by independent airline applications to new licensing board.

By Herbert J. Coleman

London—British air transport industry faces a massive re-evaluation of its future international role in a series of impending route applications that seems destined to change the pattern of its activities outside the United Kingdom.

It will be the first major test of Britain's new Air Transport Licensing Board, a body set up by the Civil Aviation (Licensing) Act of 1960 to replace the former advisory council. The act also opened up routes to independent airlines previously awarded to two state-owned airlines.

The stage was set here last week when Cunard Eagle Airways formally asked the board for permission to fly scheduled jet service between London-New York and London-Montreal, an application opposed by British Overseas Airways Corp.

In its initial testimony, Cunard Eagle contended that the annual rate of traffic increase on the North Atlantic route would justify entry of a second British airline, and that there would be "no material diversion of traffic" from BOAC.

The state-owned airline opposes this view, contending that Cunard Eagle would take away traffic developed by BOAC over a long period of years at a heavy development cost, to the detriment of British civil aviation and the taxpayers' stake in the BOAC operation.

Equally important, the final results of the new route applications will crystallize the position of Minister of Aviation Peter Thorneycroft in the structure of air transport licensing, since he retains veto powers on all decisions relating to international services and fares.

On one side are the two chosen instruments of British air transport, British Overseas Airways Corp. and British European Airways. Opposing them are the British independents which, after 17 years of development, want a larger share of the overseas business.

Prior to passage of the act, the independents primarily worked in the field of air charter and freight. But the new act allows them to enter into competition with the monopolies, and the result has been a spate of route applications, many in parallel with long-established BOAC and BEA routes.

Primarily involved are the two largest independents, British United Airways and Cunard Eagle, both formed by veteran surface shipping interests. Both recently announced orders for jet transports which they will use on the proposed routes—British United will buy 10 BAC 111 short-range jets and Cunard Eagle has bought two Boeing 707-420 long-range jets (AW May 15, p. 42) for service between London and New York in direct competition with BOAC, as well as the two U. S. flag carriers, Pan American and Trans World Airlines.

Cunard Eagle told the board last week that it prefers to "buy British" in its equipment purchases, but that the Boeing 707-420s powered by Rolls-Royce Conway engines were selected as the "suitable aircraft for the operation that will be available in time." The only British airplane that could be competitive, according to Cunard Eagle, is the Vickers VC.10 or Super VC.10 and this airplane could not be delivered until 1964.

VC.10 Considered

However, Norman Ashton Hill, a Cunard Eagle director, told the board that the airline "has the VC.10 in mind and when it is available we may well consider it for operation of the North Atlantic route."

It is this North Atlantic application, on which hearings began last week, that sharply illustrates a major dilemma for the board, and finally the minister, since approval of another British carrier will involve renegotiation of bilateral agreements with the U. S. And, still murky because the problem is not yet resolved, is the future of pool agreements between BOAC, the two U. S. flag carriers and Trans-Canada Air Lines.

Route applications for Europe, Asia and Africa, many in parallel with the monopolies, have been submitted by the independents, primarily British United, and these will be up for hearings late in June.

Both the major independents stress that their jet orders are not conditional on awarding of the routes. British United claims it needs the BAC 111 for normal expansion, and, while Cunard Eagle could use the 707s on its London-Bermuda route if it is turned down in New York, the airplanes could easily be sold to another airline.

Inextricably woven into the disputes are aspects of domestic and international politics, starting, of course, with the fact that BOAC and BEA are underwritten by British taxpayers. Another aspect, certainly due for comment by members of the opposition Labour Party in Parliament, is Cunard Eagle's relationship with its parent steamship company.

Cunard Steamship has applied for a subsidy to build a new Atlantic passenger vessel, yet Cunard Eagle financed its purchase of the two 707s (for better than $13 million) from its own funds. The opposition party, and probably BOAC, will claim that in effect the taxpayer is buying the airplanes to compete with the state-owned airline and that this could hardly be considered private enterprise.

But the initial argument which will be placed by BOAC and BEA is this:

- **Two airlines** have, over a long period of years and at vast expense, built a successful operating system, generating its own traffic.
- **Parallel routes** by the independents will only bleed off this traffic without adding new revenues, to the detriment of all concerned.

The independents take the view that they already have a proven capability and a heavy investment in an expanding air transport industry and should be allowed to demonstrate this capability.

On the whole, the arguments between the airlines involved have been kept below the surface, with occasional rumbles breaking into the open. Most marked has been the reaction of Lord Douglas of Kirtleside, BEA chairman, who lashed out against what he called "misleading statements" and turned down a request by M. D. N. Wyatt, British United chairman, to discuss the route situation in a private meeting.

However, Sir Matthew Slattery, BOAC chairman, said he would attend the meeting, but stressed his position that BOAC would go "down the line" with BEA in opposing the independents. The session, so far as is known, never was held.

Piqued by reports of a "war" between BEA and the independents, primarily British United, Lord Douglas next charged in a statement that "the companies who want some of BEA's traffic are making what is in effect a kind of takeover bid: but this is a takeover bid with a difference, because in this case those who are making the offer would not have to pay anything if they succeeded in the transaction.

"What the applicants to the licensing board in effect want is to achieve a takeover of part of a nationally owned undertaking by private interests without payment of compensation. In such circumstances it is only natural and right that BEA should uphold its position. . . . We are only seeking to safeguard a most successful and profitable national undertaking which has been built up through the efforts of its staff over the last 15 years, and to ensure the development which is essential to our continued success. . . ."

Lord Douglas told Wyatt that the meeting would "serve no useful purpose" because its only object could have been "to reach some arrangement in advance of the licensing board hearings." A BEA source put it more strongly to AVIATION WEEK: "It just smacks of making a deal in private, and that can hardly be called private enterprise."

Lord Douglas contended he will prefer to put the future of British air transport up to the licensing board so it can "exercise the functions which have been prescribed for it."

BOAC has maintained silence, with exception of reiterating its alignment with BEA.

British United's executive director, F. A. Laker, replied that airlines, including BEA, have been taking traffic from British United's owners, the shippers, for years. He added that British United also has a "substantial investment in aviation," plus the $22 million it will put into the BAC 111 order with British Aircraft Corp.

Independents' Fleets

London—Ocean shipping interests are the prime owners of Britain's two major independent airlines, British United Airways and Cunard Eagle Airways.

The breakdown of ownership and airline equipment is:

- **British United—Blue Star Line and Furness Withy, 20% each: British and Commonwealth Shipping and the Hunting Group, 18% each: Whitehall Securities, 20%, and T. L. E. B. Guinness and others, 4%.**

Equipment is four Bristol Britannia 300s, 10 Vickers Viscounts: two Douglas DC-6As and four DC-4s: nine Bristol 170s: five DC-3s: two de Havilland Herons and seven de Havilland Doves. Ten BAC 111 twin jet transports are on order, with an option on five more.

- **Cunard Eagle—wholly owned by Cunard Steamship Co., Ltd., and includes Cunard Eagle (Bahamas) and Cunard Eagle (Bermuda). Equipment is one Britannia, two Viscounts, nine Vikings, three DC-6Cs: two Herons and a Bristol 170. The airline has two Boeing 707-420s on order.**

On the other hand, Laker charged, BEA is after the holiday charter traffic which independent airlines "pioneered and built up" and contended the independents have a right to protect this traffic. Thirteen of the routes asked by British United are for seasonal holiday services. He denied any effort at "takeover," pointing out British United wants its part in a growing industry.

Varying shades of these opinions will be expanded for the next six months or so, which experts in the industry feel may be a too-optimistic time estimate.

The unknown factor is the reaction of the new Air Transport Licensing Board and current speculation is centering on whether it will be a continuation of its predecessor advisory body which reported its findings and recommendations to the Minister of Aviation for final decision.

There is a school of thought that under the law, the new board is in much the same position, in that Minister Thorneycroft can veto the final ruling and, in effect, remains a one-man tribunal. Another important factor is that appeals will be made to Thorneycroft, and in the case of the independents vs. monopolies, appeals are a certainty no matter which side comes out on top.

It is this factor alone which gives rise to the speculation that six months may be far too optimistic to decide all the ramifications of a basic dispute that will set the pattern for the future development of British air transport.

Some observers feel that because of the minister's power of final decree, the board is merely a quasi-judicial body to review evidence. Only the actual hearings and their courses will determine this, but government officials and parliamentary observers are watching this phase closely.

In one sense, the board is a sharp contrast with the U.S. Civil Aeronautics Board in that it does not have a staff of experts (examiners) to accept and evaluate evidence supplied by applications for submission to the board along with recommendations. The board will hear all evidence in public from airline representatives or counsels and will make its own evaluation.

This system has advantages, in that the board gets its information first hand and uncolored by possible influence or prejudice by a civil servant, and disadvantages because a vast outpouring of claims and statistics may bog down the entire machinery in extraneous details.

Supersonic Transport

Washington—Federal Aviation Agency technical study teams have received a presentation from one foreign manufacturer—Nord Aviation of France—interested in supplying powerplants for a U. S. supersonic transport. Described as having "quite a bit of merit" by FAA Administrator N. E. Halaby, Nord's proposal centered on its ramjet-turbojet dual cycle powerplant. Development of the U. S. supersonic transport will get under way in 18-24 months, Halaby said.

Eventually the board will have a secretariat of about 40 members who will deal with the routine matters and provide the necessary statistical material which the group will need for its findings. But it will only provide certain basic facts, not make any recommendations such as does the CAB's team of examiners.

The 10-member board is headed by Prof. D. T. Jack, an economist. It will set air service licenses in six classes:

- **Scheduled service** to specified points.
- **Nonscheduled services,** primarily inclusive tours.
- **Charter operations,** of not more than three flights.
- **Group charters.**
- **Any air transport operation** between unspecified places.
- **Any operation** other than an air transport service which is not an exempted service.

The opening sessions with Cunard Eagle and BOAC set the stage for what has turned into a flood of applications in the European market. The board will hear evidence for five days, starting June 21, on nearly 100 applications, of which 24 will be routes directly involving the monopolies and the large independents. Others come from such operators as Silver City, East Anglian, Overseas Aviation, Tradair and Starways.

In a few cases a number of operators seek a single route, such as Genoa, for which the applicants are BEA, Cunard Eagle, Silver City, British United and Tradair.

The independents last year generated about 22% of all United Kingdom air transport, according to the British Independent Air Transport Assn. Traffic has gradually increased in scheduled services (1,118,000 passengers in 1960 against 552,000 in 1956) but the independents have had setbacks in the inclusive tour field.

The association said a drop in this phase of operations is a direct result of expansion of the inclusive tour plan by the scheduled carriers (i.e., BEA) and an extention of the "closed group" system of charter that has become lucrative in the past few years.

Presidential Commission to Report On Progress in Engineer Dispute

By Robert H. Cook

Washington – Initial findings this week of a special presidential commission investigating the flight engineers' shutdown of seven airlines last February are expected to clear the way for the Kennedy Administration to permanently settle the cockpit jurisdiction feud between the Flight Engineers International Assn. and the Air Line Pilots Assn.

Appointed Feb. 23 after airline operations were resumed at the request of Labor Secretary Arthur Goldberg, the three-man commission is headed by Nathan P. Feinsinger and is scheduled to make a progress report May 24. Basic cause of the engineer walkout was a protest against a National Mediation Board decision authorizing a representation election for flight crew members at United Air Lines.

The engineers contend they would be outvoted 3-1 by members of the Air Line Pilots Assn., which would win the right to represent crew members on the airline, forcing FEIA members to join the pilots' union where low seniority ranking would endanger their future job security.

FEIA feels that if the process were permitted to go unchallenged at United, it could take place on other airlines where attempts have been made by ALPA to have third pilots take over flight engineer duties on turbojet transports.

Contending that the high productivity rate of turbojet aircraft is reducing the work force of both pilots and engineers, FEIA has suggested that the position of third pilot be eliminated and monthly flight time limitations be reduced from the present 85 hr. by contract to only 70 hr.

The union estimates that the four major turbojet operators, Pan American World Airways, Trans World Airlines, American Airlines and Eastern Air Lines, will require 7,478 flight crew members for their combined fleet by 1963 if they keep the four-man crew and the 85-hr. month. Cutting the month to 70 hr. and eliminating the fourth crewman would still provide work for about 7,400 pilots and engineers, FEIA claims.

Reasoning behind this union recommendation is a strong belief that the 70-hr. month will be accepted by the industry within two years anyway. Under the present arrangement, the four major trunks will require about 1,151 third pilots by 1963 at a total annual salary cost of $14 million, FEIA said.

Eliminating the third pilot and cutting the monthly flight limitation would cost these airlines an average 9% total salary increase the first year. But this could be completely absorbed in the two following years, and the greatly increased operational cost of keeping a four-man crew on a 70-hr. month could be averted, the union claims.

While this method of offsetting the turbojets' employment reduction process has been the subject of much informal airline discussion between airlines, it apparently has never reached the bargaining stage because of airline concern over the initial increased costs it could bring and the unsettled problems of crew complement which have caused the ALPA and FEIA dispute. The pilots' union has never officially endorsed any reduction of monthly flight times, and a move by a group of TWA pilots over a year ago to drop the third pilot in favor of a 70-hr. month was rejected by the union's executives.

Meanwhile, the presidential commission has received substantial public support from the Administration, which issued a strong challenge in earlier meetings with the pilots, engineers and airline representatives, warning them of their "last chance" to settle the dispute voluntarily or prepare to accept the commission findings with the full support of the Administration.

Remarks by Goldberg and Najeeb Halaby, Federal Aviation Agency Administrator and aviation adviser to the President, made it clear that the Administration, faced with serious and complex international problems, hopes not to spend too much time on the labor dispute and will take direct action for a settlement at the earliest possible opportunity.

Urging all parties to arrive at a "permanent" solution, Goldberg warned that "we do not permit the will of any side to prevail over the public interest" and "cannot permit a prolonged strike in the transportation industry." Indicating that Congress could legislate directly on the problem since it has done so on railroad labor problems, he called attention to the nation's international problems and emphasized that "we have to give priority to our survival as a country."

Halaby emphasized that he would support the findings of the Feinsinger panel as "the greatest opportunity yet to solve the political and economic crisis in the cockpit and to prevent the safety crisis it could generate."

Warning that Congress is "impatient and intolerant of any further disruptive warfare" in the airline industry, Halaby said that direct action which could be taken by FAA to solve the issue would include the proposal of new legislation and the use of already existing legislation "that enables government members of the aviation community to take action to promote safety, economy and harmony."

IATA Airlines Settle Atlantic Cargo Rates

International Air Transport Assn. airlines last week adopted a new pattern of sharply reduced North Atlantic air cargo rates designed to offset the industry's growing capacity surplus by encouraging more high volume shipments.

Agreement between IATA members on a rate structure, which is expected to cut shipping costs between New York and London as much as 65%, also has averted the strong possibility of an open rate situation after the current North Atlantic cargo tariffs expire June 30 (AW Feb. 20, p. 38).

A February IATA traffic conference ended in a deadlock over the cargo issues, and a rate war appeared imminent. The tariff expiration date of Apr. 10 was later extended to June 30.

Pending approval by the governments concerned, the new rates will become effective Sept. 1 and remain in force until Mar. 31, 1963. Present rates will be extended to permit adequate time for tariff filing with the governments.

Core of the agreement is a system of progressive reductions in general cargo rates at various high volume breakpoints, combined with a streamlined system of specific commodity rates to develop special cargos between specific points. In its final form, the new rate structure represents a compromise between U. S. carriers, who wanted rates cut across the board at progressively higher volume breakpoints, and other airlines, which favored lowering rates within a system of commodity classification based on the existing specific commodity rate pattern.

Balancing a system of weight breakpoints against a reduced list of specific commodities, the formula will offer these rates in the New York-London market: shipments under 100 lb., $1 per lb.; under 220 lb., 69 cents; under 550 lb., 50 cents; under 1,100 lb., 41 cents; under 2,200 lb., 36 cents and over 2,200 lb., 33 cents. Present rates over this route begin at $2.81 for shipments under 100 lb., go to $1.81 for 1,100 lb.

Reflecting the heavy volume of cargo shipped from New York compared with European cities, the new system also provides a special rate of 31 cents per lb. for New York shipments exceeding 16,500 lb.

MATS Evaluates Bids for $80 Million

By David H. Hoffman

Military Air Transport Service last week began evaluating the bids of U.S. airlines competing for about $80 million in Fiscal 1962 overseas airlift, Logair and Quick Trans contracts which MATS plans to award next month.

One series of contracts due to emerge from the competition represents the first major MATS commitment to purchase overseas airlift on an annual basis since awards worth $39,566,137 were parcelled out to the industry for the year beginning Oct. 1, 1959.

Defined in a May 4 MATS request for proposals, the new contract possibilities for overseas airlift probably will produce more than $50 million in revenue for the winning airlines. Considerably more passengers and considerably less cargo will be transported abroad under the Fiscal 1962 contracts compared with the 1959 awards.

The change in this year's passenger-cargo ratio apparently reflects the phasing in of MATS Boeing C-135 freighters and the phase-out of aging Douglas C-118 and C-124 transports. MATS is scheduled to receive its first C-135 in June, and the balance of a 30-aircraft order is to be delivered by early summer, 1962.

Increased U.S. concern with the political and military situation in southeast Asia is underscored by one contract under which a commercial carrier will airlift 3,420 passengers to Don Muang Airport, Bangkok, Thailand. About 285 passengers per month during Fiscal 1962 will be moved between U.S. air bases and Bangkok, which is about 300 naut. mi. from Vientiane, administrative capital of Laos.

Logair, Quick Trans Potential

Although overseas procurement accounts for about 60% of total dollar volume, the interest of all-cargo, supplemental and uncertificated carriers last week centered on the Logair and Quick Trans bid requests. Together, these represent a revenue potential of about $35 million. To be eligible for consideration, bids must be received at MATS headquarters not later than May 22.

MATS invited 69 carriers to respond to the Logair request, which incorporates these key points and changes:

- **Specifications requiring** an aircraft capable of hauling "outsize cargo" over long-range routes were omitted, as was all mention of outsize cargo.
- **Airlines received the equivalent** of permission to combine the carriage of commercial and military cargo from point to point in the Logair route structure (AW May 1, p. 61).
- **Uncertificated carriers**—those responsible to the Federal Aviation Agency but not the Civil Aeronautics Board—were allowed to compete for contracts only after a last-minute amendment had been telegraphed to the rest of the industry.

In the Fiscal 1961 Logair bid request, MATS listed a requirement for two types of aircraft capable of carrying bulky hardware, such as engines and missile components, to and from Strategic Air Command bases and aerial ports of embarkation. Riddle Airlines fulfilled one such requirement by acquiring a fleet of Armstrong Whitworth AW 650 freighters. The other went to Zantop Air Transport, an uncertificated carrier based in Detroit.

Zantop won its contract by agreeing to begin operating the first of five Lockheed C-130B turboprop transports not later than Mar. 31, 1961. Failing to conclude satisfactory financial arrangements with Lockheed, the carrier could not meet this deadline and now is fulfilling the contract with Douglas C-54 and Curtiss C-46 type aircraft.

The Riddle contract probably will be extended through Fiscal 1962 by negotiation. But MATS also was expected to issue a second set of specifications calling for an outsize cargo aircraft larger than the Argosy, with aft-end, truckbed-height loading characteristics.

The cost of putting the C-130B through an FAA certification program may have been the major stumbling block to inclusion of this specification in the Logair bid request. Certificated C-130Bs probably would not be available for at least another year even if such a program were undertaken. By waiting for an additional year or two, MATS might be able to induce carriers to modernize their Logair fleets with the so-called optimum airfreighter, the Lockheed C-141.

Original form of the Logair request specified that only proposals submitted by "an air carrier within the meaning of the Federal Aviation Act of 1958" would be considered. This prerequisite was interpreted to mean that uncertificated carriers—those that operate under Part 45 of the Civil Air Regulations—were excluded from the competition.

When the "air carrier" clause was deleted, certificated airlines expressed concern that their uncertificated competition, lacking union labor forces and operating with low fixed costs, would file cut-rate proposals. These rates could be accepted by MATS, which generally

Air-India Affirms New York Flight Plan

New York—Air-India International plans to fly daily transatlantic schedules to New York next April regardless of failure to win this concession from the U. S. State Department in talks which concluded without agreement on May 11.

B. R. Patel, vice chairman and general manager of Air-India, said here last week that India had been prepared to make concessions to gain the daily frequency, but found "no common ground" in the discussions. U. S. authorities would not even consider negotiating for reciprocal concessions on the basis of daily Air-India frequencies, Patel said. Air-India now operates five weekly schedules on the route, and Patel said daily service is basic to its plans for next year.

The schedules will be operated, Patel said, and "let them take me to court." He said the Indians were prepared to give the U. S. carriers an immediate increase from six to 10 frequencies and also to make certain adjustments in the previously held principle of predetermined frequencies. Patel said it was very difficult to understand why the U. S. wouldn't even listen to any proposition that included the daily service for Air-India.

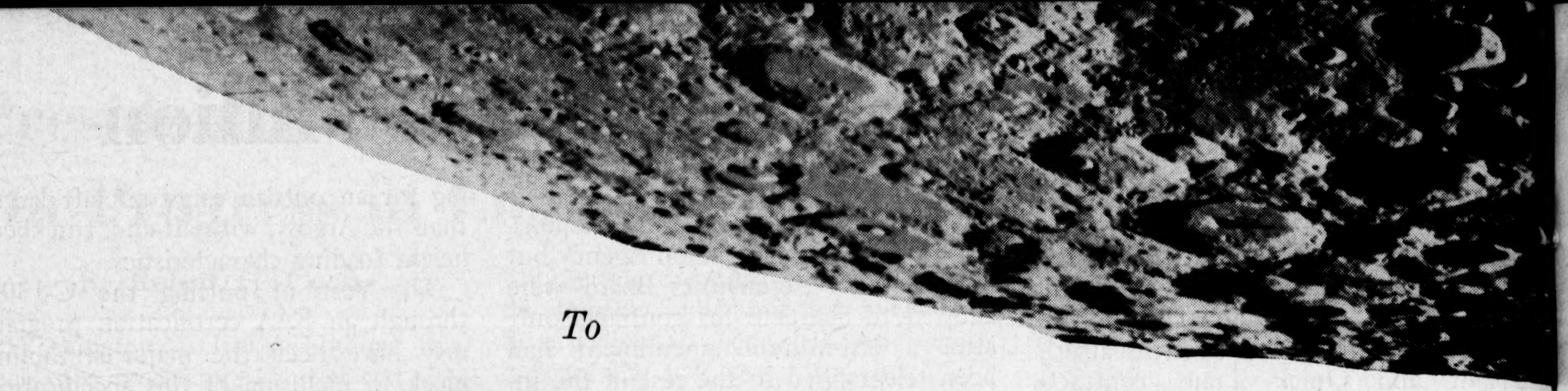
The Air-India official said there are 300 weekly frequencies across the Atlantic now, and undoubtedly there will be an increase next year, when seven flights by Air-India would be an insignificant inroad on traffic availability in the U. S. market.

Patel said, however, that he expects talks to be resumed fairly soon. Without daily transatlantic service, he said, he doesn't believe Air-India could successfully operate into the U. S.

At the same time, according to officials of the airline, delays in Export-Import Bank financing of 80% of Air-India's order of two additional Boeing 707-420 jets could result in a loss of the order.

These officials connected a reported hedging on the part of the bank with the breakdown of India-U. S. negotiations. The bank was to finance 80% of the order with private U. S. financial sources providing the other 20%.

In the event the loan was not forthcoming, the officials indicated, Air-India might go elsewhere for additional jet equipment. They mentioned de Havilland Comets as possible equipment to handle the airline's routes to the Far East.



To

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CALTECH'S JPL RANGER, to carry research instrument packages to the moon, will rely upon precision design, construction, testing and performance of Motorola electronic equipment. Comprehensive measurements of operational and navigational data aboard will be assembled for transmission by its Flight Data Encoder. An all solid state Transponder generates the telemetry carrier, receives ground commands, and translates carrier frequencies for two-way Doppler velocity measurements. ☆ In laboratories and at launch site, Payload Test Sets will check out the spacecraft RF communications system. At NASA's transmitter and receiver sites, Calibration Beacons will check command transmitter performance and radiate precise signals to test telemetry receivers. ☆ Motorola's participation in Ranger lunar probes demonstrates its space communications capabilities for frontier programs.

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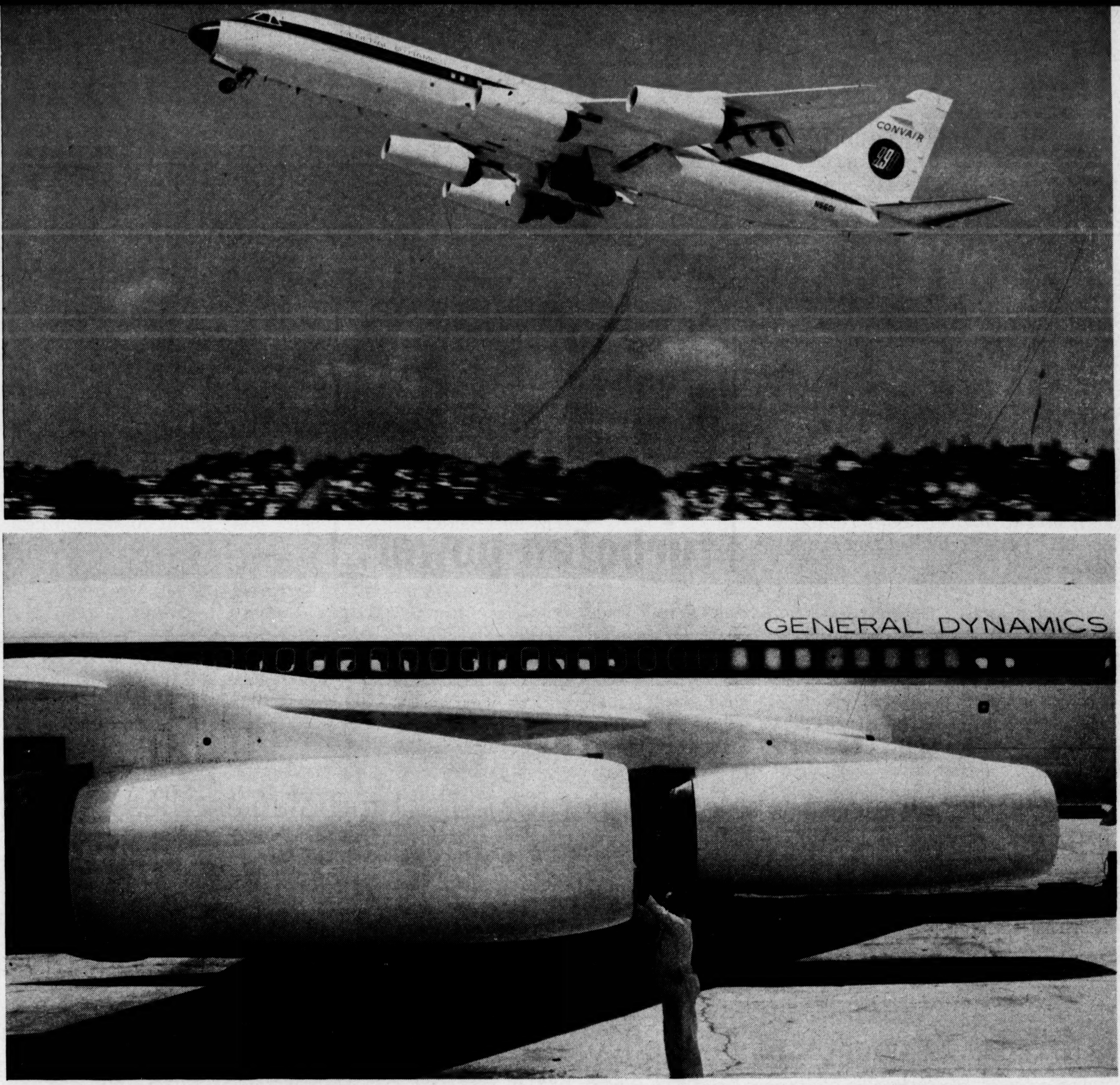

Convair 990 Flown to Mach 0.97 to Prove Pylon Changes

Convair 990 recently was flown to a speed of Mach 0.97 to prove the modifications incorporated in the outboard engine pylons. The company's engineers report that the successfully completed high-speed test removes all doubt as to whether or not the fixes are in the final configuration. The 990 recently underwent rework involving shortening the outboard engine pylons by 28 in. to eliminate a limited-cycle pod oscillation. Final proof that the oscillation was removed by the modification was afforded by the high-speed flight which saw the aircraft dived at Mach 0.97 from an altitude of 32,500 ft. to 22,500 ft. Accurate airspeed readings were recorded by a Lockheed F-104 pacer from Edwards AFB, Calif. The 990 was over the Pacific Ocean between Santa Catalina Island and San Diego when it attained its maximum speed. True airspeed at 0.97 would be 592 kt. or 679 mph. at 22,500 ft. Requirement laid down by the Federal Aviation Agency that an aircraft be demonstrated to Mach 0.05 faster than the certificated speed was exceeded by the 990 which will be operated at a Mach number of 0.91. Test pilot Don Germeraad said that he is now certain that the fixes are final and he is "happily surprised" that the 990 went to the limit speed with only 20% of the "shivers and shakes" which are normally expected. General Dynamics/San Diego officials say that the certification program now can be continued with the satisfaction that the previously experienced pod oscillation problem (AW Mar. 27, p. 38) is solved.

has opposed rate floors, without prior approval from CAB.

This is because certificated airlines must obtain CAB exemptions in order to fulfill MATS contracts that entail flight along routes not covered by a carrier's operating certificate. In passing on these exemptions, CAB has set a minimum rate of 2.9 cents per passenger mile and a minimum rate for cargo based on aircraft type.

The Board also has indicated (AW May 1, p. 45) that it might consider lower than minimum rates "on the basis of additional information" that showed how a carrier could operate at a profit with less revenue.

In all three of this month's bid requests, the Air Force anticipated a possible CAB move in this direction by providing that carriers needing exemptions can bid rates lower than the Board minimums. However, the carriers must offer proof that the lower rates "will compensate . . . for all applicable costs in connection with the specified services and return a reasonable profit."

Bids filed under this provision must be accompanied by an alternative offer based on CAB minimum rate standards. This would set the contract price at the alternate rate automatically if CAB should deny exemption requests.

JT3D

A progression of turbofan power.

JT3D designates a whole group of twin-spool, turbofan engines designed and built by Pratt & Whitney Aircraft, as shown in the power growth chart below. These turbofans are the offspring of the record-making J57 jet engine. The turbofan uses approximately 15 per cent less fuel at comparable cruising thrust than the conventional jet. Pratt & Whitney Aircraft's JT3D family provides a broad range of available power—17,000 to 24,000 pounds of take-off thrust, or more. This thrust increase can be accomplished with little effect on the radial size of the engine, and with a substantial decrease in specific weight.

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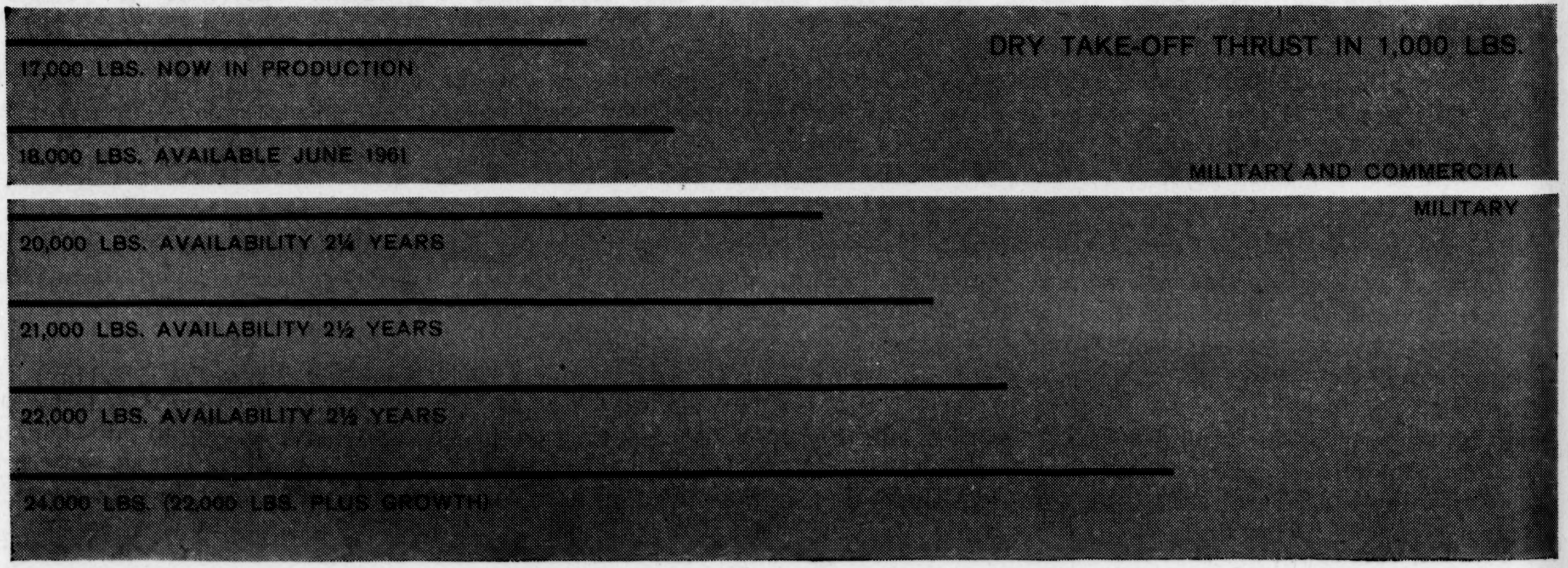

American's 727 Letter of Intent Spurs Boeing Short-Range Outlook

New York—Boeing Co. has intensified its lead in the U. S. short-medium range jet field substantially with American Airlines' signing of a letter of intent to buy 25 three-engine 727s with the first delivery in 1964. An order will be contingent on contract terms and airplane specifications now being negotiated between American and Boeing.

Price was not disclosed, but the 727 now is selling for about $4.5 million, totaling approximately $112.5 million without spares for the 25-plane order. Boeing's 727 sales, including American's letter of intent, now total 117 aircraft.

American considered the Sud Caravelle twin-jet, the de Havilland DH 121 and tentative designs of other manufacturers before reaching its decision. The airline reportedly was considering something smaller than the 727, gross weight of which is 142,000 lb. with a maximum seating capacity of 114.

The 25-plane order of 727s would most likely complete American's requirements for some time to come—unless a merger changed the situation. Such an order would give the airline a total of 99 jets, of which 74 would be Boeing models and all of which would be turbofan powered.

Financing of the possible 727 order has not yet been arranged, but the 1964 delivery date allows ample time for suitable arrangements to be made. American President C. R. Smith said at the stockholders' meeting at which the letter of intent was announced that no short-term financing during this year is anticipated. Funds for purchase of previous equipment, he said, have been arranged on a sound, long-range basis.

Smith said excessive capacity continues to exist on many airline routes, and some carriers are adding jet capacity faster than the rate of traffic growth for the industry.

A big question mark remaining in the short-jet field domestically now is Trans World Airlines, which is taking a hard look at short-range equipment including the 727 and Caravelle.

Status of American manufacturers other than Boeing in the short-haul jet field, an Aviation Week survey discloses, is as follows:

- **Convair** has a number of engineering studies to "see whether we can build a jet transport approximately equivalent to the Convairliner that would interest airlines. As yet we have no meaningful answers."
- **Douglas Aircraft** market analyses and preliminary design studies are going on but nothing significant has emerged. No name or number has been applied to such a project. Douglas is still attempting to sell the Caravelle under its agreement with Sud.
- **Lockheed design** studies have been made on a short-haul transport in the 440 category, but nothing has resulted from the studies involving a name or designation.
- **McDonnell** has released no information on such a project, but is considered to be working on an airplane in this category.

Boeing itself has been conducting a study program on a 737 model in this class, but it is considered still a paper airplane and no orders are in hand.

An-14 Changes

Moscow – Soviet Antonov An-14 Pchelka (Little Bee) light transport has undergone extensive modification since it was first unveiled in 1957. The seven-place, twin-engine aircraft—well behind schedule but reported ready for commercial use—features a pair of redesigned vertical stabilizers with straight leading edges. In its original configuration, the An-14 was fitted with vertical stabilizers shaped like the letter D and curved at their leading edges.

Moscow-Cuba Route Planned by Aeroflot

Moscow—Chief of the Soviet airline Aeroflot has offered clear evidence that the Russians intend to operate a Moscow-Havana route even if talks break down with the U.S. on an exchange of air service between New York and Moscow.

Speaking at Vnukovo Airport here, Colonel General Yevgeny Loginov, the Aeroflot chief, said that plans already are under way to inaugurate the Cuban service. Loginov did not mention the route to be flown, the equipment to be used or the status of bilateral negotiations with the U. S.

In its response to earlier U. S. overtures (AW Mar. 6, p. 41) aimed at a New York-Moscow route exchange, however, the Soviet Union indicated that four-turboprop Tu-114s would be used and that these could operate nonstop between Havana and Moscow.

Loginov's remarks were made during an exhibition of commercial aircraft—a show at which no new types were displayed to the public. The event marked the opening of Aeroflot's "spring and summer navigation season" and stressed the carrier's technical progress at this point in the 1959-1964 seven-year plan.

Foreign correspondents were barred from the exhibit, but speaking to the Soviet press, Loginov said:

- **Tu-124 twin turbofan transport** with a seating capacity of 43-68 passengers will be "widely used" on international as well as domestic routes "in the very near future." Berlin, Vienna and Bucharest probably will receive initial Tu-124 service. First public inspection of the Tu-124 was made last spring.
- **Antonov An-24 twin-turboprop** transports seating 32-40 passengers will replace twin-engine Il-12s and Il-14s and single-engine An-2s and Yak-12s on domestic feeder routes this year. Loginov listed the An-24s latest performance capability as a 310 mph. cruising speed, a 30,185 ft. maximum ceiling and a 16,400 to 19,680 ft. practical ceiling.
- **Aeroflot's fleet** of turbine-powered aircraft—Tu-104s, An-10s, Il-18s, Tu-114s, Tu-124s, An-24s "and others"—will be carrying about 90% of all the airline's passengers in 1965. Three years ago, Aeroflot predicted that 85% of its passengers would be carried by turbine-powered aircraft in 1965. Aeroflot reports its 1962 figure will be approximately 62% (AW Mar. 27, p. 43).
- **Moscow will handle** about 50,000 air passengers daily by the end of 1965. Rate of Aeroflot's traffic growth has surpassed that of all other carriers, including those in the U. S., Loginov said. Aeroflot already has the world's lowest domestic passenger fares, he claimed, and it plans to make a further 20-30% reduction in the next two years.

To illustrate Aeroflot's technical progress, Loginov said that "navigational radio stations and hundreds of other radio installations have been partially or completely automated" and that all Soviet airways are within range of radar capable of monitoring aircraft courses.

Tu-114 Takeoff Weights

Moscow—Takeoff weight of Aeroflot's four-turboprop Tu-114s now operating nonstop between Moscow and Khabarovsk in eastern Siberia is about 352,800 lb., well below the aircraft's maximum gross weight of 396,900 lb. Maximum gross weight of long-range Douglas DC-8s and Boeing 707s, by comparison, is about 315,000 lb. Aeroflot claims the 170-passenger Tu-114s arrive at Khabarovsk with enough reserve fuel to go on to Vladivostok or Pyongyang, North Korea, or to return to Novosibirsk—a total flight of about 5,600 naut. mi., even over great circle routes.

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THE WORLD'S ONLY "MISSION MODULE" HELICOPTER

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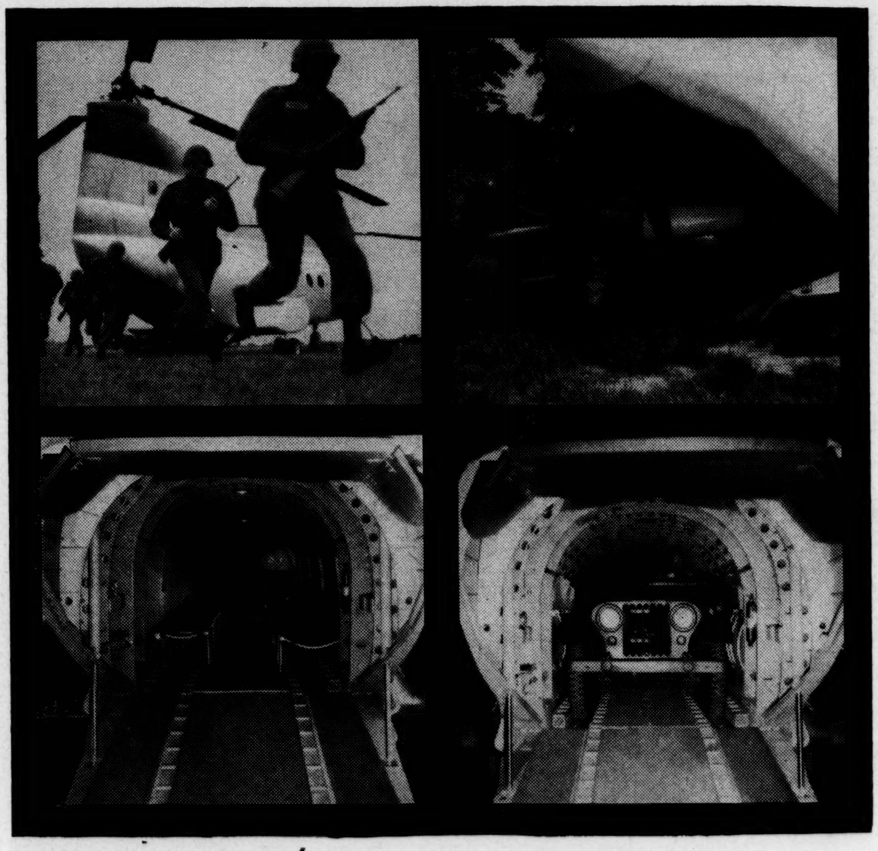
"Mission module" design of the new, twin turbine-powered, Boeing-Vertol 107 means this truly versatile helicopter can perform a wide range of military assignments—without costly or time-consuming conversion. A change from cargo mission to minesweeping can be made readily because of basic aircraft design.

In addition, an integrated loading system can be built into this *first* all-mission, all-service helicopter. With the new system one man working alone can unload up to two tons of military cargo in three minutes or less. Even under demanding field conditions, loading can be completed in as little as eight minutes. The fully integrated system makes use of the Boeing Vertol 107's straight-in rear loading ramp. It includes recessed rollers and cargo beams which, when stowed inside the 107, serve as guides for vehicle wheels. A built-in hydraulic winch speeds loading, while the nose-up ground attitude permits fast gravity or taxi unloading. The loading system does not interfere with use of the Boeing Vertol 107 as troop transport, and troop seats can be quickly stowed along the fuselage sides to permit other "mission module" use—for ASW, land or sea rescue, medical air evacuation, missile site support.

The Boeing Vertol 107's capability to perform many missions such as these makes it the logical choice for today's flexible and alert Armed Forces.



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TOP PHOTO: FULL SCALE DEVELOPMENT MOCKUP

AIR ALGERIE
FRANCE

AIR ALGERIE Caravelle is seen at Orly Field, Paris, northern terminal point of company's service between Algeria and France.

Air Algerie Future Hinges on Peace Talks

By Robert E. Farrell

Algiers—Future of France's largest private airline—Air Algerie—is sure to be affected by peace negotiations finally getting under way between the French government and Algerian nationalists.

The carrier, set up in its present form in 1953, just one year before the Algerian rebellion broke out, is entirely owned by French interests. The two largest stockholders are Compagnie Generale Transatlantique (French Line) and Compagnie de Navigation Mixte, French shipping outfit. Air France holds no stock or other interest in the Algiers-headquartered airline.

Capitalized at roughly $4 million, Air Algerie last year hauled 563,329 passengers—more than twice as many passengers as did France's second largest private carrier, Union Aeromaritime de Transport (UAT). A third private French international operator, Compagnie de Transports Aeriens Intercontinentaux (TAI), carried 86,500 passengers last year.

Serves 32 Points

Air Algerie, however, can hardly be classified as an international airline. Its only stop other than French and Algerian points is Geneva. No service is provided even to neighboring countries such as Morocco and Tunisia. Four-fifths of the company's traffic is carried between France and Algeria, the balance within Algeria itself. In all, the line serves 32 points.

Much of Air Algerie's trans-Mediterranean traffic, of course, is inflated due to the rebellion, or is based on vacation trips by settlers to French points. Still, Algeria's budding industrialization, as well as rich oil and natural gas discoveries, are providing increasing portions of over-all traffic.

Barring complete failure of present peace negotiations, most observers are agreed Air Algerie is due for a sharp alteration in its development.

Carrier Prestige

Any political agreement between French and Algerian nationalist negotiators is bound to grant Algeria its full sovereignty. Experience throughout Africa has shown that one instrument of prestige new nations demand is an international carrier. Thus it is unlikely Air Algerie would be permitted to maintain its current French-granted operation unless it expanded its service to western Europe and other points in Africa. It is also likely that any sovereign government in Algiers would demand participation, if not control, over the carrier's capitalization.

Air Algerie officials, while well aware of such possibilities, refuse to comment on the matter. They merely note that Air Algerie took delivery on four Caravelles in 1960 and a fifth in April of this year. A sixth is scheduled for delivery in June.

The carrier also holds an option on two additional Caravelles.

Another possible future development which could overtake Air Algerie is a merger with Royal Air Maroc and Tunis Air, the two national carriers of Morocco and Tunisia. Air France presently is closely involved in the op-

AIR ALGERIE Noratlas is used on cargo flights within Algeria, mainly to service oil drilling centers in the Sahara. Note wingtip Turbomeca Marbore turbojets used on takeoffs. Air Algerie uses three of these Nord 2502 Noratlas aircraft. Aircraft in background is one of two Constellations withdrawn from service. The Constellations and some of the airline's DC-4s are being retired as Caravelles are introduced to take their places.

Qantas Bid Highlights Bilateral Dissension

By L. L. Doty

Washington—Wide-spread disagreement over the interpretation of the bilateral air transport agreement between Australia and the U.S. again focuses attention upon the need for clearly defined lines of authority within the U.S. government on international civil aviation issues.

Latest dilemma in which the U.S. finds itself in the area of international aviation stems from a bid by Qantas Empire Airways to serve Tahiti on its Australian-U.S. transpacific route. The case, which now awaits an initial decision by Civil Aeronautics Board Examiner Joseph L. Fitzmaurice, already is embroiled in arguments over whose interpretation of the bilateral will take precedence—State Department's or the CAB's.

So far, testimony during hearings and in briefs has been centered around the question of whether Australia was implicitly given Tahiti traffic rights in the amended bilateral agreement with the U. S. or in the Agreed Minute, a specific part of the bilateral. But interwoven is the continuing question of where authority lies prior to the time the case goes to President Kennedy.

Here is how the various parties to the case now stand on the bilateral issue:

- **Qantas holds that the original** Air Transport Services Agreement between the U.S. and Australia, as amended by an Exchange of Notes, includes Tahiti as a point on the transpacific route even though the stop is not specifically mentioned in the terms of the agreement. The airline contends that the general phrase "via intermediate points" in the route description of the agreement is sufficient authorization for the grant of a foreign air carrier permit allowing Qantas traffic rights in Tahiti.
- **Bureau Counsel, in its brief,** doubts that the bilateral agreement includes Tahiti as an intermediate point on grounds that the delegations to the negotiations "did not express any intention to include" Tahiti as a stop and no reference to the Society Islands was included in the minutes kept by the U.S. delegation.
- **State Department has taken** the official position that Tahiti is covered by the bilateral agreement but Bureau Counsel has asked the examiner to petition State for reconsideration of this stand. Bureau Counsel calls the State interpretation of the agreement "relevant" but not "conclusive."
- **South Pacific Air Lines,** which has said that the Qantas competition in Tahiti would be disastrous to it, claims that there is nothing in the agreement, the Agreed Minute or minutes of the negotiations to suggest that Tahiti was intended as an intermediate point on the Qantas route.
- **Pan American World Airways** took no stand at all on the bilateral issue. The airline said the key point in the case was whether the President and the CAB should give a foreign flag carrier traffic rights which they have declined to give any U.S. flag carrier.

Kennedy Must Decide

In the last analysis, it is President Kennedy who will make the final decision as to whether Qantas' foreign air carrier permit will be amended to permit the airline to serve Tahiti. According to accepted practice, Kennedy would base his decision on advice from State and on the reasons for granting or denying the route outlined by the Civil Aeronautics Board in its order accompanying the foreign air carrier permit submitted for Kennedy's signature.

State Department, again according to accepted practice, has jurisdiction in the negotiations of bilateral agreements. The Board is represented in such bargaining as members of the U. S. delegation. The airlines are not participants in the talks but are apprised of the progress of the talks and are given opportunities to state their positions on the issue at stake.

CAB has jurisdiction in the issuance of foreign air carrier permits in accordance with the terms of the bilateral agreement. But the Board's decision can be, and has been, reversed by the President if matters of foreign relations or policy become overriding factors. Thus the State Department is in a position to exert its influence in the final decision on any international route matter.

State Department, of course, has no doubts as to its authority in the interpretation of a bilateral agreement. In the Qantas case, State has given its interpretation and presumably does not intent to reconsider its position.

Bureau Counsel, in its Qantas brief, held that in the "vast majority of cases the [State] Department's position would be compelling." It added that the Board admitted in the BOAC Service to Tokyo Case (AW Apr. 27, 1959, p. 38) that State's interpretation of bilateral agreements normally is "controlling."

If noted, however, that in the BOAC case, the Board made it clear that it was itself determining the bilateral interpretation question at hand, and that it had not conceded that the function belonged entirely to State.

South Pacific Air Lines, in its brief, saw no doubt that the CAB was the ruling body in the interpretation of bilateral agreements. It held that the Board has the primary responsibility of deciding whether an "obligation" exists in an agreement for the purpose of making a decision as to whether a foreign air carrier permit should be issued.

The airline was pointed and explicit in outlining the procedures which it thought should be followed in handling international route cases. It said that the power to interpret and apply statutes must remain with a regulatory body and that the State Department's primary responsibility lies in the negotiation of bilateral agreements.

It said CAB should act as an adviser to the President and that State makes its recommendations to the President through comments on the Board's recommendations. The carrier noted that both State and the CAB have independent access to the President but added that it is unreasonable to expect the Board to defer to State's views on matters of law or policy.

Meanwhile, in a notice to parties, Fitzmaurice denied a Bureau motion that a request for a reconsideration of position should be submitted to State. He added that the question of whether Tahiti is included in the bilateral agreement will "be decided by the examiner in his recommended decision to the Board in this case."

CAB Route Case Stay Requested by American

Washington—American Airlines asked the Civil Aeronautics Board last week to stay its order in the Southern Transcontinental Service Case and threatened to request a court review of the case.

The airline contended that the June 11 effective date of the Board's decision, granting new transcontinental routes to Delta Air Lines and National Airlines plus a Dallas-New Orleans-Miami route to Eastern Air Lines, does not permit sufficient time for CAB consideration of American's petition for reconsideration or for the granting of a court stay.

Pointing out that more time is needed to complete a scheduling changeover resulting from the decision, American estimated its earnings will be reduced $15 million annually by the order and said that CAB denial of the petition will bring a request for court review of the case. A stay of the Board's decision pending such a review would still be necessary to prevent immediate damage to American, the carrier said.

Airline Income and Expenses—February 1961

	Passenger Revenue	U. S. Mail	Express	Freight	Charter	Total Operating Revenue	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNK								
American	$18,988,267	$487,778	$249,820	$1,452,633	....	$21,501,834	$27,549,835	−$6,048,001
Braniff	5,286,829	162,848	77,030	203,713	$1,759	5,631,636	5,849,845	−344,989
Capital	7,634,955	32,242	110,379	169,544	....	7,451,084	8,578,832	−1,127,748[3]
Continental	4,689,000	107,000	54,000	125,000	16,000	5,010,000	4,752,000	20,000
Delta	11,702,000	236,000	110,000	306,000	....	12,590,000	11,130,000	1,239,000
Eastern	14,884,718	376,460	....	804,210[4]	....	16,074,757	20,772,513	−4,928,292
National	4,126,223	87,893	16,865	150,995	19,451	4,501,000	5,310,158	−889,120
Northeast	4,202,659	46,721	27,476	90,049	....	4,462,107	4,524,149	− 62,042[3]
Northwest[1]	....	....	....	....	....	....	....	....
Trans World	12,238,098	359,699	....	1,042,225[4]	109,118	14,023,062	19,334,775	−6,199,823
United	26,793,000	1,259,173	....	2,456,141[4]	25,914	28,619,725	30,851,744	−2,546,051
Western	2,774,092	61,779	....	172,599[4]	40,493	3,057,928	3,922,081	−931,705
INTERNATIONAL								
American	315,540	5,690	210	47,912	....	391,481	536,933	−145,452
Braniff	818,143	27,916	....	59,017	....	939,407	1,067,843	−150,236
Caribbean Atlantic	307,489	2,755	....	13,611[4]	8,193	335,423	283,927	51,994
Delta	110,000	1,000	....	5,000	....	126,000	220,000	−101,000
Eastern	2,129,418	49,678	....	127,183[4]	....	2,307,777	2,467,012	−215,252
Mackey	149,910	....	1,281	5,780	....	179,026	151,186	27,839
National[7]	....	....	....	....	....	....	....	....
Northwest[1]	....	....	....	....	....	....	....	....
Pan American Combined	16,193,000	2,101,000	....	2,569,000	1,353,000	23,360,000	29,467,000	−7,426,000
Alaska	189,000	13,000	....	24,000	....	227,000	413,000	−194,000
Atlantic	6,066,000	912,000	....	968,000	675,000	9,087,000	13,111,000	−4,198,000
Latin America	4,837,000	170,000	....	783,000	27,000	6,308,000	7,982,000	−1,678,000
Pacific	5,101,000	1,006,000	....	794,000	651,000	7,738,000	7,950,000	−357,000
Panagra	1,197,000	57,000	....	42,000	....	1,569,000	1,776,000	−195,000
Resort[8]	....	....	....	....	....	....	....	....
Trans Caribbean[1]	....	....	....	....	....	....	....	....
Trans World	1,516,285	433,285	....	446,773[4]	51,831	2,720,354	5,370,373	−2,911,746
United	1,650,474	91,460	....	46,826[4]	....	1,825,078	1,299,746	488,534
Western	177,346	3,827	....	6,124[4]	....	188,097	324,932	−144,045
LOCAL SERVICE								
Allegheny	736,085	32,549	16,940	27,758	....	1,269,392	1,542,154	−272,762[3]
Bonanza	489,748	4,600	2,638	4,953	1,363	761,257	633,164	150,597
Central	188,517	6,100	2,998	7,620	13,156	459,645	464,285	−4,640[3]
Frontier	600,763	23,409	5,207	25,488	4,083	1,131,552	1,080,620	36,724
Lake Central	238,295	5,326	6,916	....	1,764	487,895	516,935	−29,040[3]
Mohawk	798,302	16,974	12,370	18,343	23,102	1,293,175	1,219,790	73,385[3]
North Central	1,140,854	36,249	25,000	31,701	....	1,854,410	1,920,357	−86,248
Ozark	581,776	19,814	11,189	18,562	6,318	1,076,457	988,426	88,031[3]
Pacific	453,443	10,121	3,001	4,867	53,345	825,190	823,319	−29,145
Piedmont	463,631	8,415	5,351	8,621	....	818,785	928,617	−132,011
Southern	386,840	15,602	5,034	10,140	4,813	742,997	782,505	−21,247[3]
Trans-Texas	374,902	13,135	5,567	14,405	2,452	698,069	697,146	−2,797
West Coast	533,321	10,589	3,302	7,684	3,278	979,046	885,492	76,159
HAWAIIAN								
Aloha	325,977	1,969	....	4,793	423[2]	352,150	412,863	−60,713[3]
Hawaiian	397,735	2,861	....	65,505	91,183[6]	572,125	702,964	−130,839[3]
CARGO LINES								
AAXICO[8]	....	....	....	....	....	....	....	....
Aerovias Sud Americana[1]	....	....	....	....	....	....	....	....
Flying Tiger	....	10,156	....	661,588[4]	1,143,061	1,835,124	2,113,098	−337,863
Riddle	....	....	....	1,276,633	....	1,313,580	1,148,562	121,892[3]
Seaboard World	....	564,407	....	655,457	183,664	1,421,284	1,623,048	−201,764[3]
Slick	....	....	....	....	....	1,463,511	1,333,742	129,769[3]
HELICOPTER LINES								
Chicago Helicopter	110,626	122,746	....	....	....	233,949	280,233	−46,745
Los Angeles Airways[1]	15,860	12,270	11,458[9]	....	....	122,302	124,146	−639
New York Airways	66,919	3,314	2,826	3,183	....	261,324	289,278	−28,791
ALASKA LINES								
Alaska Airlines	192,497	50,406	665	35,622	232,192	693,167	684,335	5,340
Alaska Coastal	48,966	8,342	....	7,011	1,038	142,100	161,363	−19,263[3]
Cordova	10,504	8,360	....	9,299	11,063	85,215	89,635	−5,505
Ellis	30,200	3,400	....	3,700[4]	500	81,200	109,100	−27,900[3]
Kodiak	9,558	834	....	1,669	691	16,015	20,967	−4,952[3]
Northern Consolidated	48,550	48,720	....	21,097	....	214,086	242,314	−28,228[3]
Pacific Northern	405,982	89,372	2,548	100,670	3,043	797,200	886,770	−94,834
Reeve Aleutian	86,411	43,232	....	33,498	1,746	171,930	174,563	−2,873
Western Alaska	10,464	18,457	....	1,780[5]	5,566	36,323	34,490	−4,352[3]
Wein Alaska	42,118	48,322	....	20,330	10,755	291,664	280,230	−11,434[3]
Avalon Air Transport[1]	....	....	....	....	....	....	....	....
Samoan[1]	....	....	....	....	....	....	....	....

[1] Not available. [2] Non-scheduled transportation or other transportation. [3] Net operating profit or loss. [4] Property. [5] Freight and excess baggage. [6] Non-scheduled transportation. [7] No overseas operations this month. [8] Operations suspended. [9] Includes excess baggage.

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

AIRLINE OBSERVER

▶Several South American airlines have expressed interest in a configuration of the Lockheed JetStar that could carry up to 21 passengers over very short-haul routes. High-density seating arrangement would place passengers along the sides of the cabin with their backs toward the windows.

▶Negotiations that could lead to a merger between the Swissair-Scandinavian Airlines System consortium and KLM Royal Dutch Airlines are continuing on a monthly basis. But KLM officials opposed to the union still contend that strength cannot be gained "by adding weaknesses" and that the Dutch could not expect to win new landing rights in the process.

▶Watch for congressional action to retain the present 10% transportation tax before June 30, when the levy drops to 5% under present legislation. Hearings have been concluded on the tax before the House Ways and Means Committee, which is expected to meet May 29 to approve a report on the tax bill. Senate consideration of the House bill is not expected to meet enough opposition to delay Senate approval by the deadline.

▶Kennedy Administration's proposals for new and increased taxes on aviation fuels is causing concern among several major oil producers. At least one large producer, Humble, has been contacting airline economists to conduct a detailed study of aviation fuel and oil consumption on a state-by-state basis, pinpointing the total costs and various taxes involved.

▶United Air Lines is waiting for results of a private investigation which it has underwritten to pinpoint the cause of the Dec. 16 midair collision between a United DC-8 and a Trans World Airlines Super Constellation over New York. United says the prime target of the Armour Research Foundation study will be detailed research into the adequacy and reliability of airways navigational aids.

▶Boeing will install and evaluate an automatic flare-out system, developed by North American's Autonetics Division, on its 707 prototype as part of an effort to give its jet transports improved all-weather capability.

▶Bilateral discussions may be opened between U.S. and British representatives June 5 in London to discuss future route patterns and schedules in the newly formed West Indies Federation, which includes Jamaica, the Barbados, Antilles and Trinidad. Present agreement was negotiated with the British and will be changed to reflect the federation's pending independence.

▶Civil Aeronautics Board is considering several changes in the new class mail rate subsidy formula for local service airlines. A major revision which the Board expects to make by January will be a reduction in the subsidy increases caused by the addition of new intermediate points on airline routes. Airline economists estimate that under the present subsidy formula, added operational costs of serving new intermediate points approximate $200,000 a year, with a 40-passenger aircraft providing two round trips a day.

▶U. S. airlines' share of the total world air traffic dropped to less than 60% last year for the first time in the post World War II period. International Civil Aviation Organization figures record a traffic growth of only 7% over 1959 for the U. S. carriers, compared with 25% and 21% for European and Latin American airlines. Despite traffic gains, a 16.5% increase in seat capacity dropped the world's airlines' average load factors from 56.9% in 1959 to 55.5% last year.

▶United Arab Republic is completing plans to establish air service connecting Cairo with the capitals of all African states. First of the new services, between Cairo and Casablanca, would be inaugurated by year-end.

▶KLM Royal Dutch Airlines is operating its turbofan-powered Douglas DC-8 from Arlanda Airport near Stockholm, Sweden, to train air crews while the transport awaits Federal Aviation Agency certification. KLM will keep the DC-8 at Arlanda for two months in order to train 30 pilots, using parts furnished by Scandinavian Airlines System for maintenance.

SHORTLINES

▶**Civil Aeronautics Board** has hired CEIR, a Washington computer firm, to study the feasibility of converting the Board's statistical activities to an electronic data processing operation.

▶**Continental Airlines** reports operating revenues of $1.1 million for the first quarter of 1961—a 38% increase over the same period last year. Profit was $164,000, triple its earnings for the same 1960 period.

▶**Czechoslovak Airlines** has begun direct service to Cambodia from Czechoslovakia—making it the 28th country with which the airline has direct connections.

▶**Delta Air Lines** operated its Convair 880s at a 64.14% load factor during their first year of passenger service, which ended this month.

▶**Federal Aviation Agency** has banned operation of portable FM radios after May 25 on all civil aircraft using VHF navigation equipment. FAA's Bureau of Research and Development has found that reception of Instrument Landing System (ILS) and Terminal Visual Omni Range (TVOR) signals can be impaired by the FM radios.

▶**Federal Aviation Agency** rule requiring flight recorders on civil jet transport training, check, ferry and test flights will be effective June 6. Under exceptions to the rule, carriers can fly aircraft without operating flight recorders when they are flying to bases where the recorders will be installed or repaired.

▶**KLM Royal Dutch Airlines'** fleet of Electras will be complete this month with the scheduled delivery of its 12th Lockheed turboprop transport. KLM's Electras operate mostly in North and West Africa and the Near and Far East.

▶**Pan American World Airways** reports total operating revenues for the first quarter of $87.3 million, compared with $85.7 million for the same period last year. Net loss after taxes was $6.4 million, compared with a $2.1 million loss for the 1960 first quarter. Pan American said the February flight engineers strike contributed to the increased loss.

▶**San Francisco & Oakland Helicopter** Airlines has received the first of two turbine powered Sikorsky S-62 helicopters the carrier has ordered for operation of passenger service in the San Francisco Bay area. The second S-62 is to be delivered later this month.

Who saw the Crab Nebula first?

The year was 1054 and Chinese and Japanese astronomers dutifully recorded a heavenly explosion that occurred some 4,000 years before they saw it. This nova, then bright as Jupiter, faded from sight until the 18th century, when telescope-equipped observers rediscovered the nova remains, later named the Crab Nebula.

Today, such a stellar explosion would bring a world-wide family of J. W. Fecker telescopes into operation. In fact, almost *any* celestial novelty, supernova or artificial satellite, is observed through Fecker telescopes or tracking equipment. Often these observations are made continents apart and are timed within 700 seconds of each other . . . not 700 years.

J. W. Fecker is the country's oldest and most experienced manufacturer of telescopes. Our developments, combining optics, electronics, hydraulics and pneumatics, are used by government, industrial and research institutions the world over.

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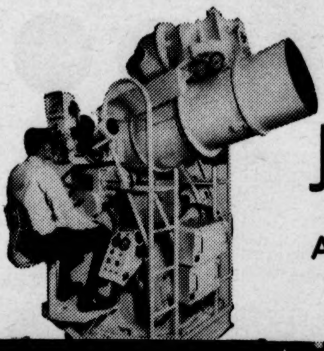
ENGINEERS AND PHYSICISTS! Opportunities of unusual scope for practical men who dream. *J. W. Fecker Division, American Optical Company, 6259 Hamilton Avenue, Pittsburgh 6, Pennsylvania.*



J. W. FECKER DIVISION

AMERICAN OPTICAL COMPANY

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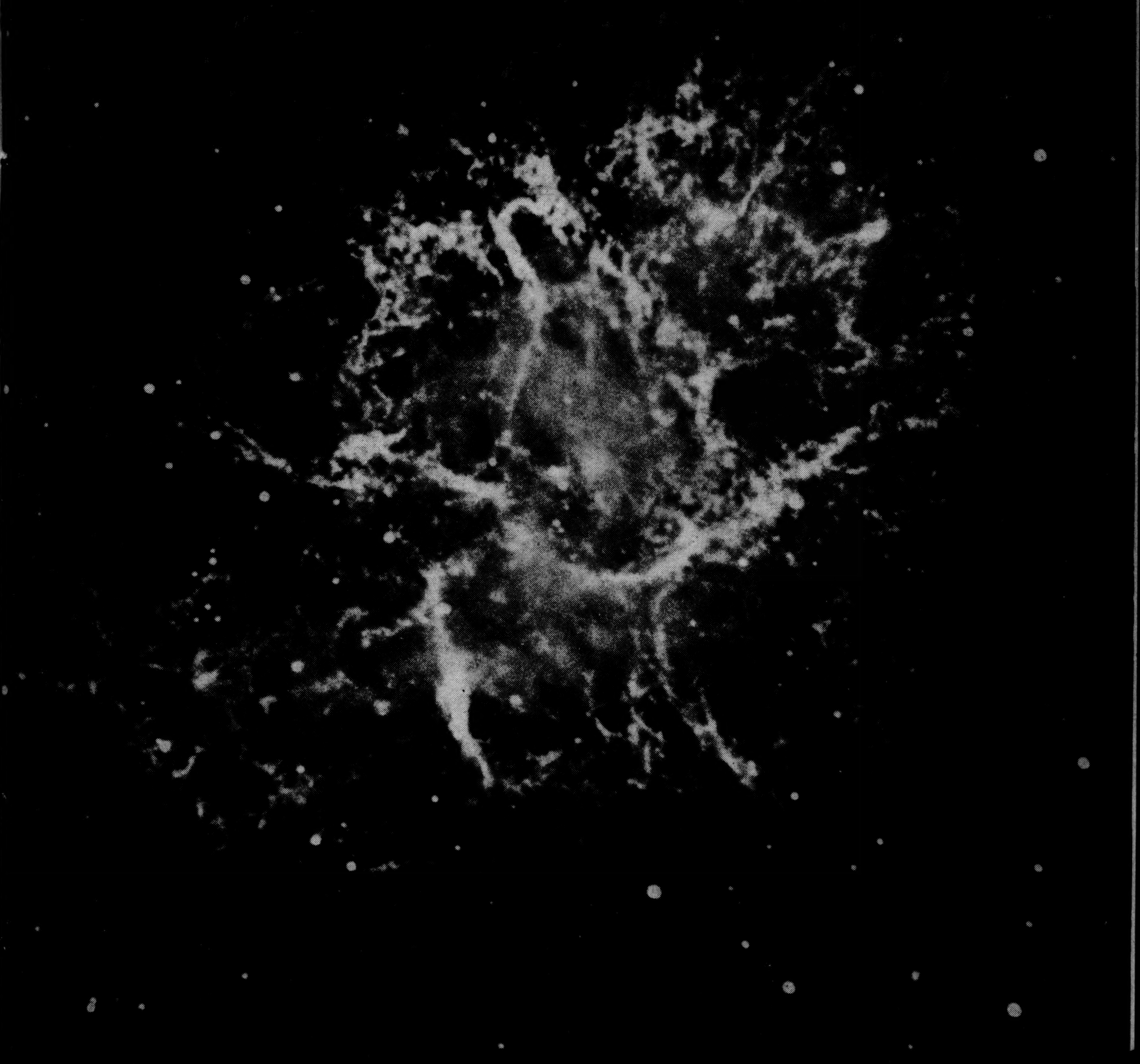
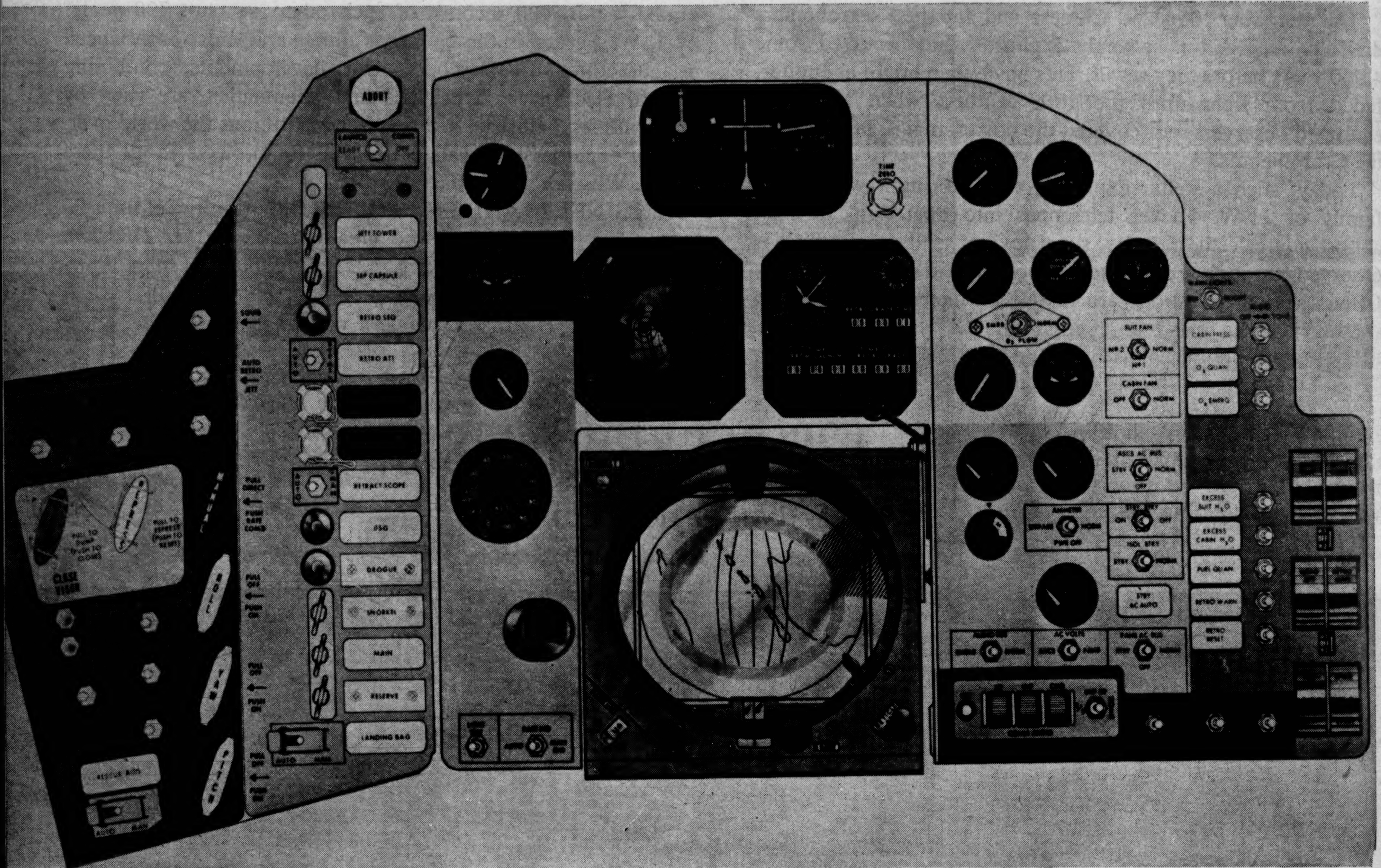




BASIC instrument panel layout for manned capsules features periscope (bottom center) topped by Earth Path Indicator and clock.

How Mercury Capsule Design Evolved

By David A. Anderton

St. Louis—Development of the Project Mercury space capsules was a new kind of challenge to the engineering teams at McDonnell Aircraft Corp.

There was no previous experience to draw on in the design of a man-carrying capsule. Earlier experience with high-speed aircraft and missiles was useful in some areas, but had been done to a time scale measured in terms of five to ten years. Mercury had about two to three years to make good.

The program, which originally envisioned the use of "off-the-shelf" systems and hardware to a large extent, rapidly outgrew the limitations of much of that kind of equipment, and ended by pioneering real advances, both in specific design areas and in the state of the design art.

With the safety of the astronaut first on the list of requirements, McDonnell engineers had to be ready and willing to make changes at any time or place in the program if that change were geared to an increase in the man's safety or performance.

Design of the capsule had to be done in parallel with its testing by McDonnell and the National Aeronautics and Space Administration's Space Task Group, which worked in close collaboration with the company team and was, in the final analysis, responsible for the success or failure of the project.

And finally, the decision to use available boosters imposed a rigid weight limitation on the design of the capsule. It meant that rigorous weight control was a mandatory preliminary design procedure, to be considered right at the beginning, instead of anywhere down the stream. It dictated miniaturization of components ". . . everywhere except on the man himself," as one McDonnell engineer said.

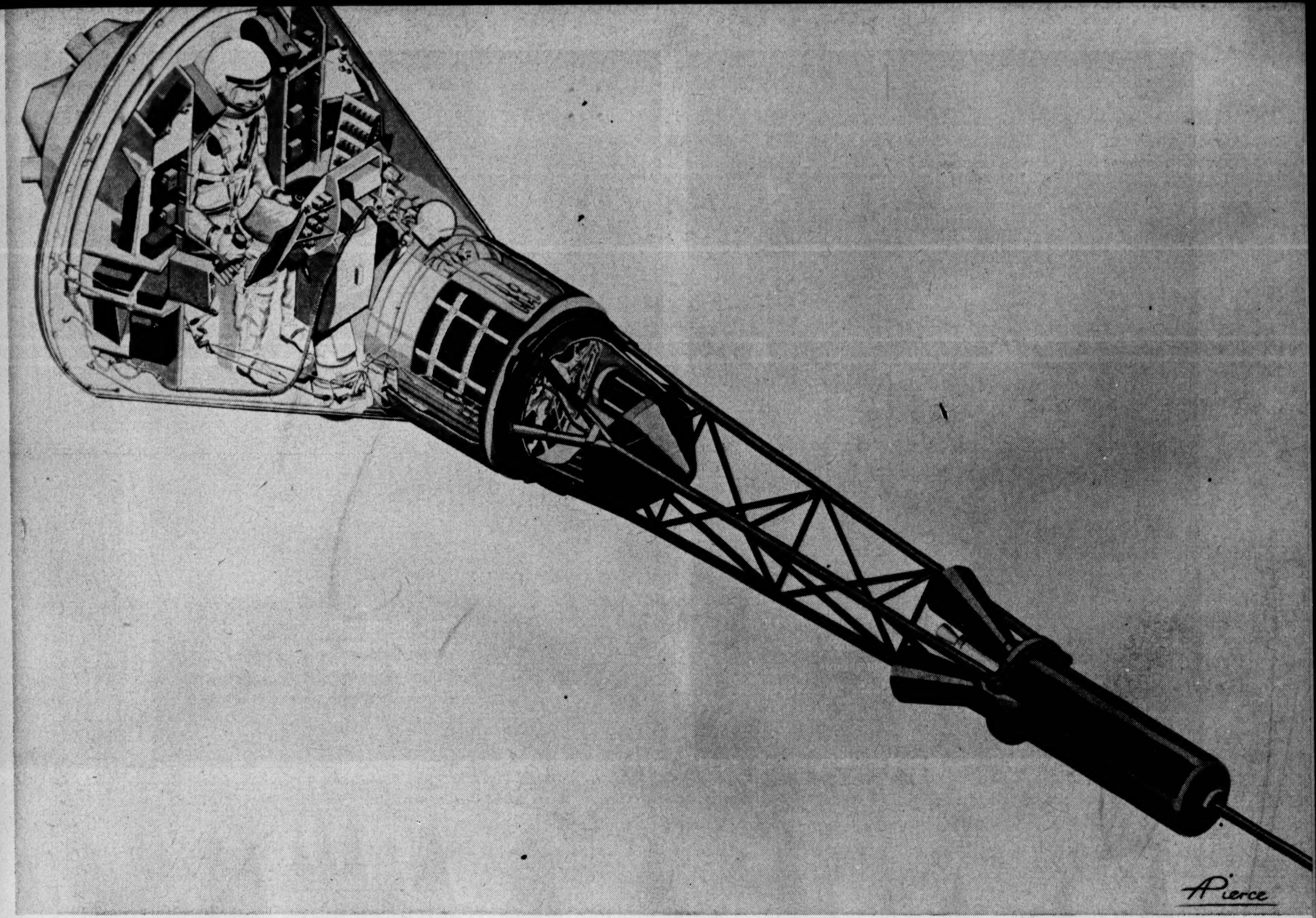
In periodic slaps at the U.S. space program, McDonnell has received its share of criticism aimed at its Project Mercury work. Slippage, design changes and high costs are among the charges directed at the program.

Right now, 29 months after winning the competition, McDonnell teams can point to the successful flight of Astronaut Alan B. Shepard, Jr. (Cdr., USN) (AW May 15, p. 29) as the best proof in their behalf.

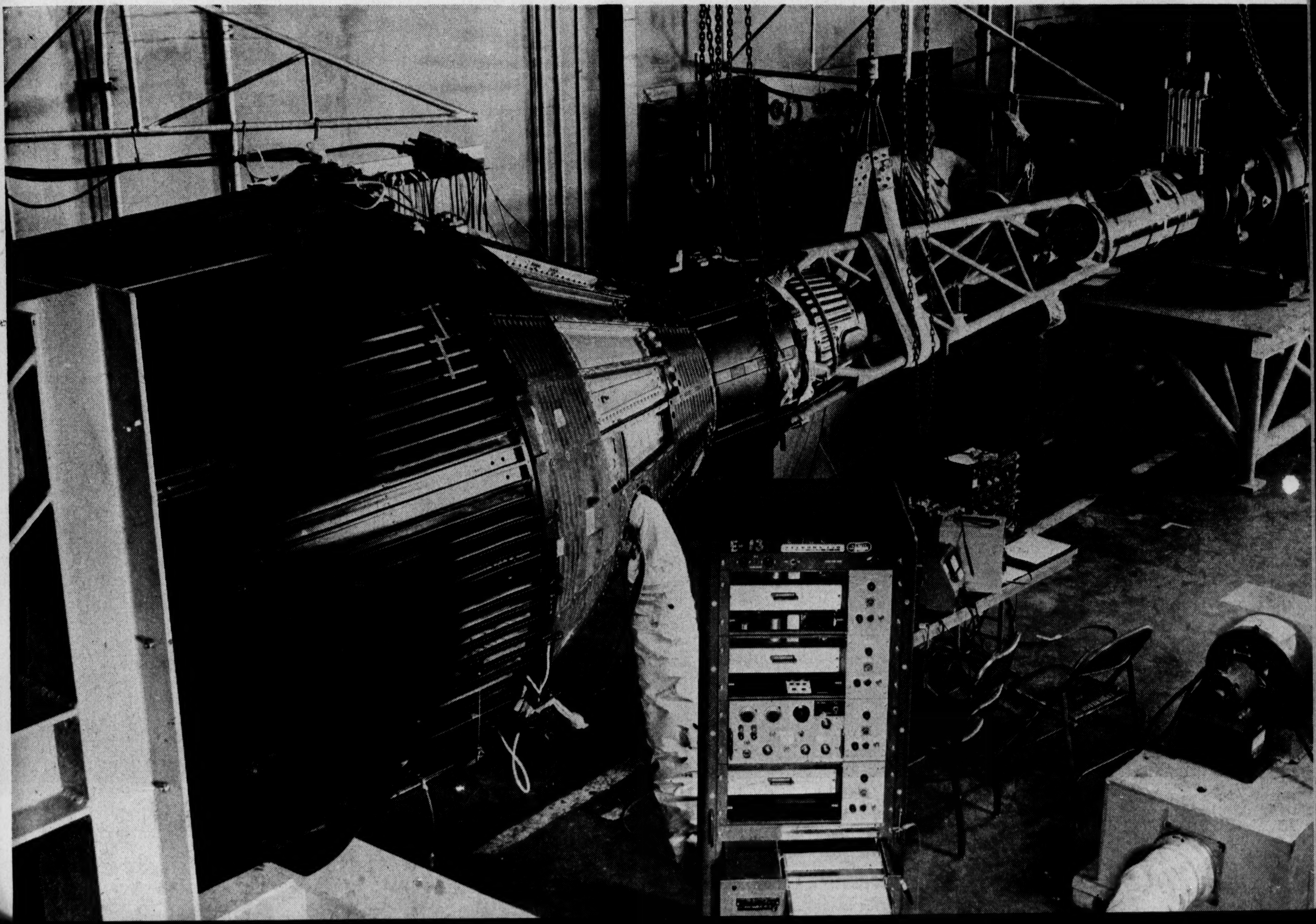
Design changes are normal on any project, and were required on the Mercury capsule any time there was a possibility that they would contribute to the astronauts' safety. Queried about one statement that there were over 130 design changes on the capsule, McDonnell's E. M. Flesh, who manages the Mercury effort for the company, sighed that he wished there had been that few.

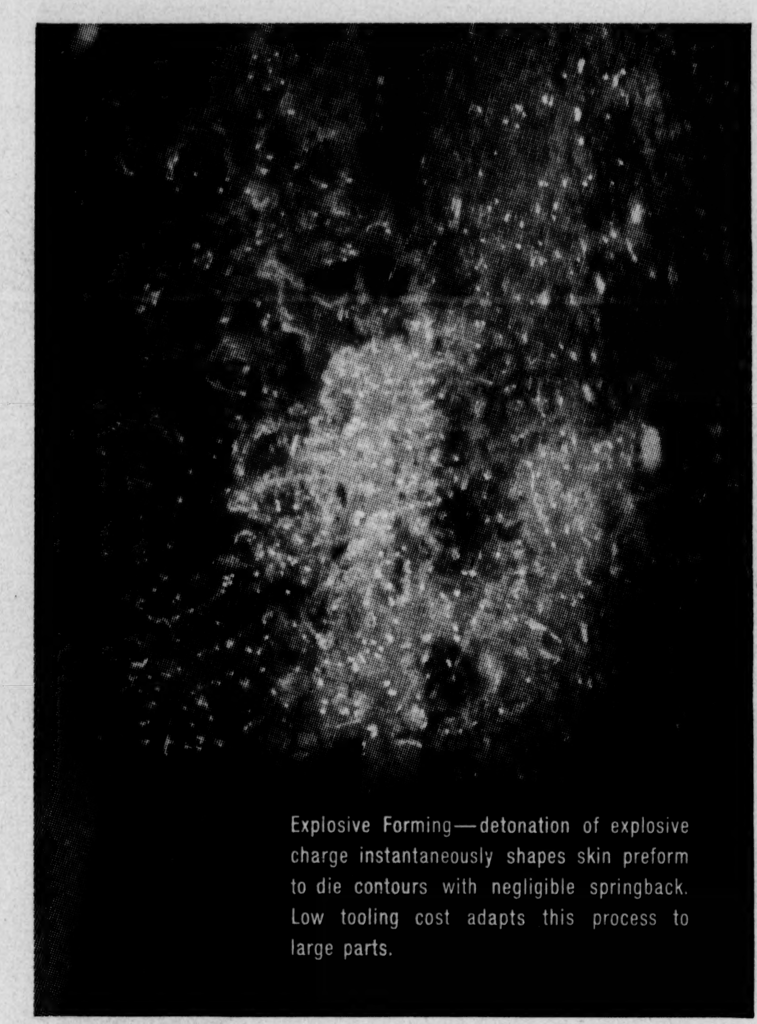
So far, McDonnell has received a total of $110 million for its work, covering the design, development, testing and procurement of 20 capsules and two complete procedural trainers, procurement of all systems, development and procurement of all ground-support equipment including checkout gear, all payments to subcontractors, and all launch support for the series of firings, including salaries of the launch pad crews.

The company has received a follow-on order for six more capsules, designated Mark II, from NASA. Actual spending on the order is limited to $2.5 million, covering the purchase of long lead-time items. There is speculation that these six capsules will have multiple

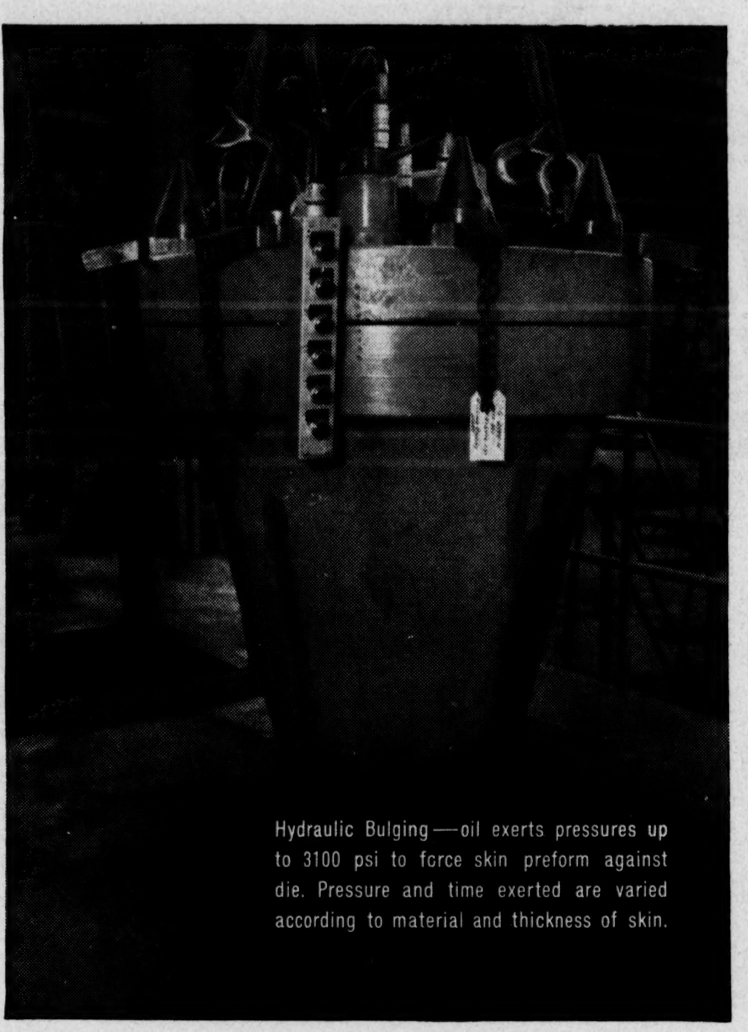


CUTAWAY of complete Mercury capsule and escape tower shows internal details of systems. Escape tower is jettisoned after successful lift-off, and capsule is oriented so that blunt base is forward along the trajectory. Below, capsule and tower get shake test at McDonnell.

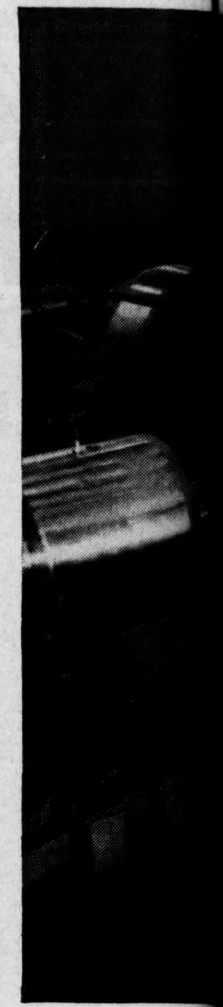


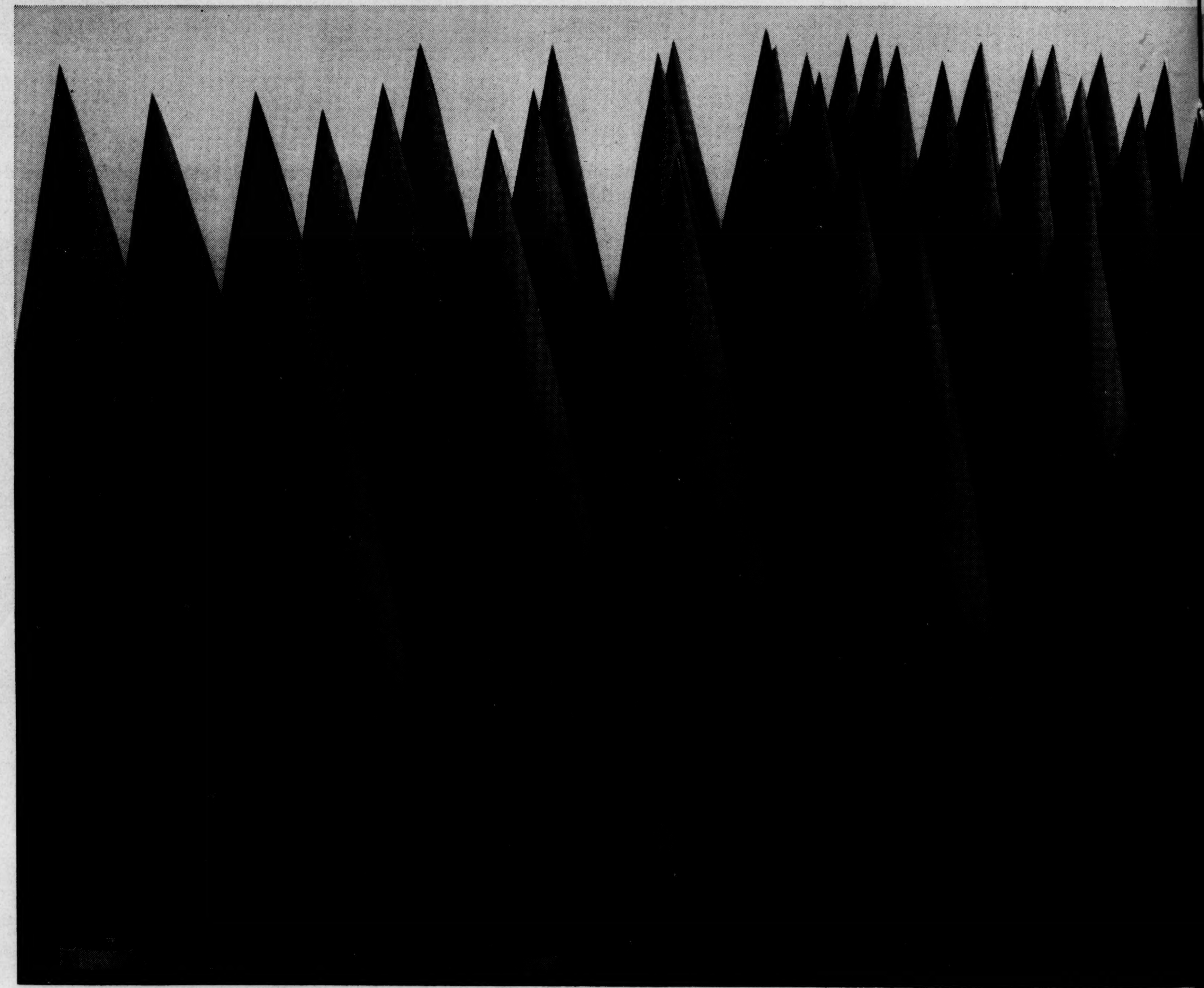


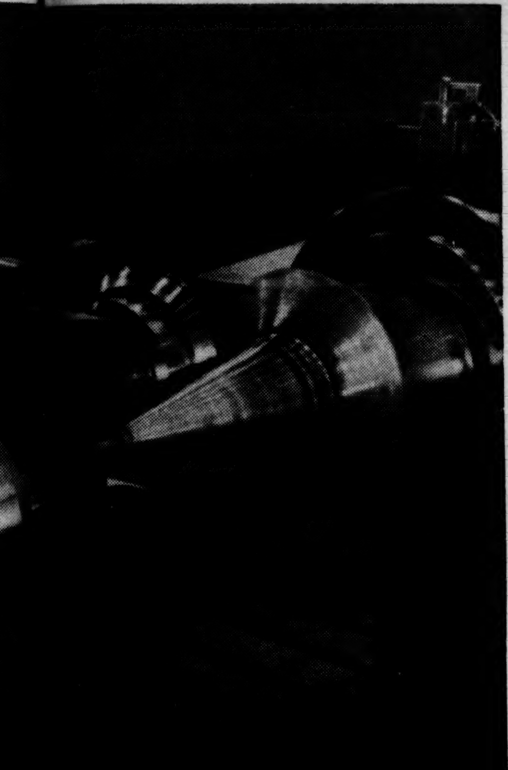
Explosive Forming—detonation of explosive charge instantaneously shapes skin preform to die contours with negligible springback. Low tooling cost adapts this process to large parts.



Hydraulic Bulging—oil exerts pressures up to 3100 psi to force skin preform against die. Pressure and time exerted are varied according to material and thickness of skin.







w Turning — hydraulically-driven roller mlessly extrudes stock to conform to ndrel shape. This method offers excellent trol of front bulkhead thickness.

Advances in explosive forming at Honeywell add a vital alternative method to skin fabrication techniques!

Recent advances in explosive-forming provide a third alternative method of skin fabrication. Only Honeywell has complete facilities for all three methods of skin fabrication—hydraulic bulging, flow turning, and explosive forming—and thus can recommend the best method for a given job. Skin fabrication is another in the growing list of capabilities for systems management available through Honeywell's Military Products Group.

Explosive forming is opening important new production potentials with its inherent advantages of flexibility, reproducibility, reduced dimensional tolerances and extremely low scrap rate. This method will form certain metals and alloys that cannot be formed by other processes, and constitutes an important part of Honeywell's present development work on skin fabrication.

Early in 1951 Honeywell pioneered refinements of the hydraulic bulging method of skin fabrication as a part of the developmental work on the Honest John warhead. These refinements resulted in faster production, closer tolerances and interchangeability of parts. Since then Honeywell capabilities in skin fabrication have broadened continually and Honeywell has been a steady supplier of missile skins for many critical projects.

As new techniques of fabrication were developed, they have been translated into production facilities that will now handle a complete job from raw material to finished product. Production facilities for shearing, routing, stamping, welding, planishing, forming, drilling, trimming, and polishing are available.

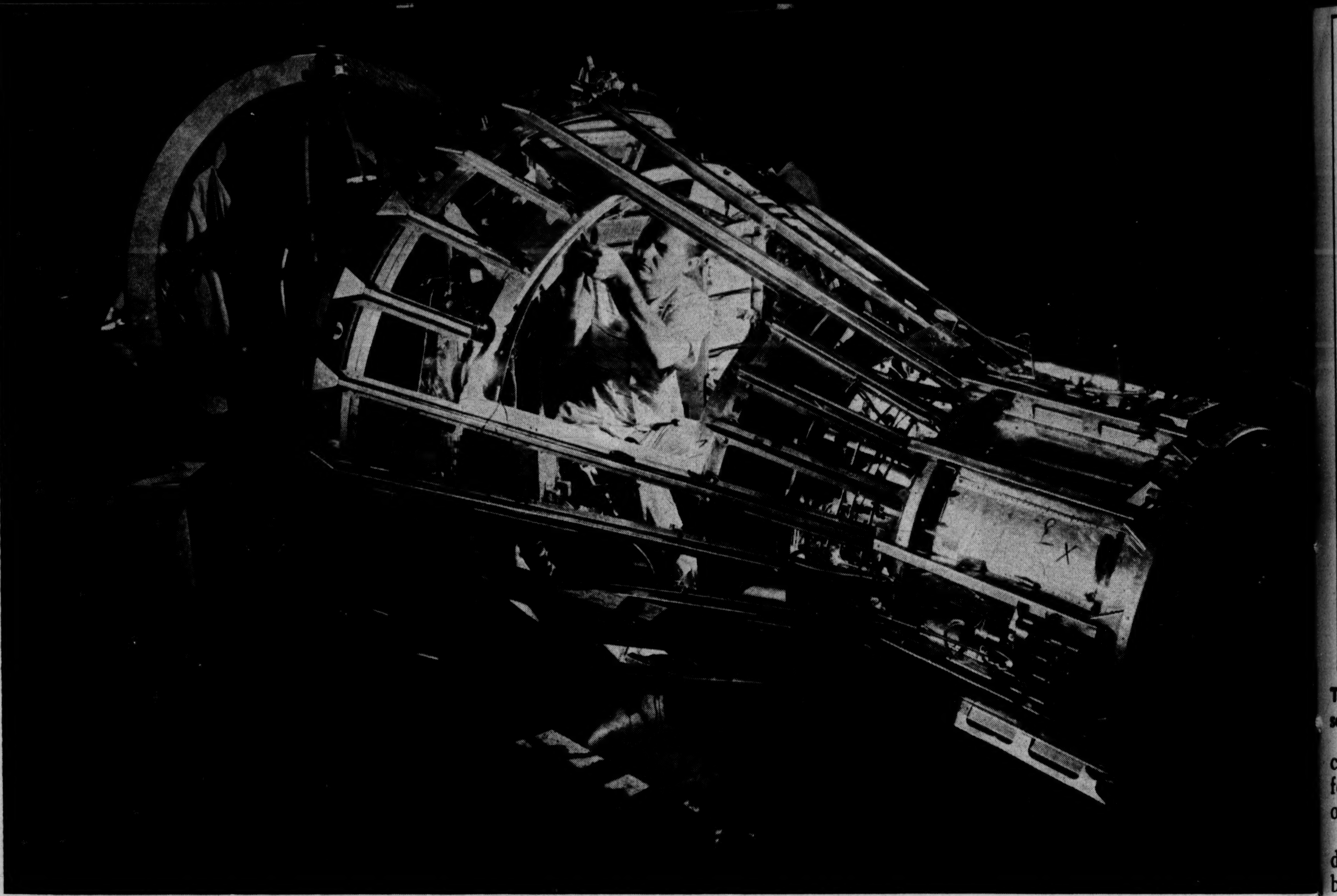
Honeywell's advanced research and development work has extended dimensional capabilities as shown in the following chart:

	Hydraulic Bulging		Explosive Forming		Flow Turning	
	Current	Potential	Current	Potential	Current	Potential
Diameter	up to 3 ft.	unlimited	up to 1 ft.	unlimited	up to 1 ft.	up to 5 ft.
Length	up to 5 ft.	unlimited	up to 3 ft.	unlimited	up to 3 ft.	up to 8 ft.
Wall Thickness	.060-.125″		.060-.080″		.060-.080″	
Thickness Tolerance	±.010″		±.002″		±.005″	

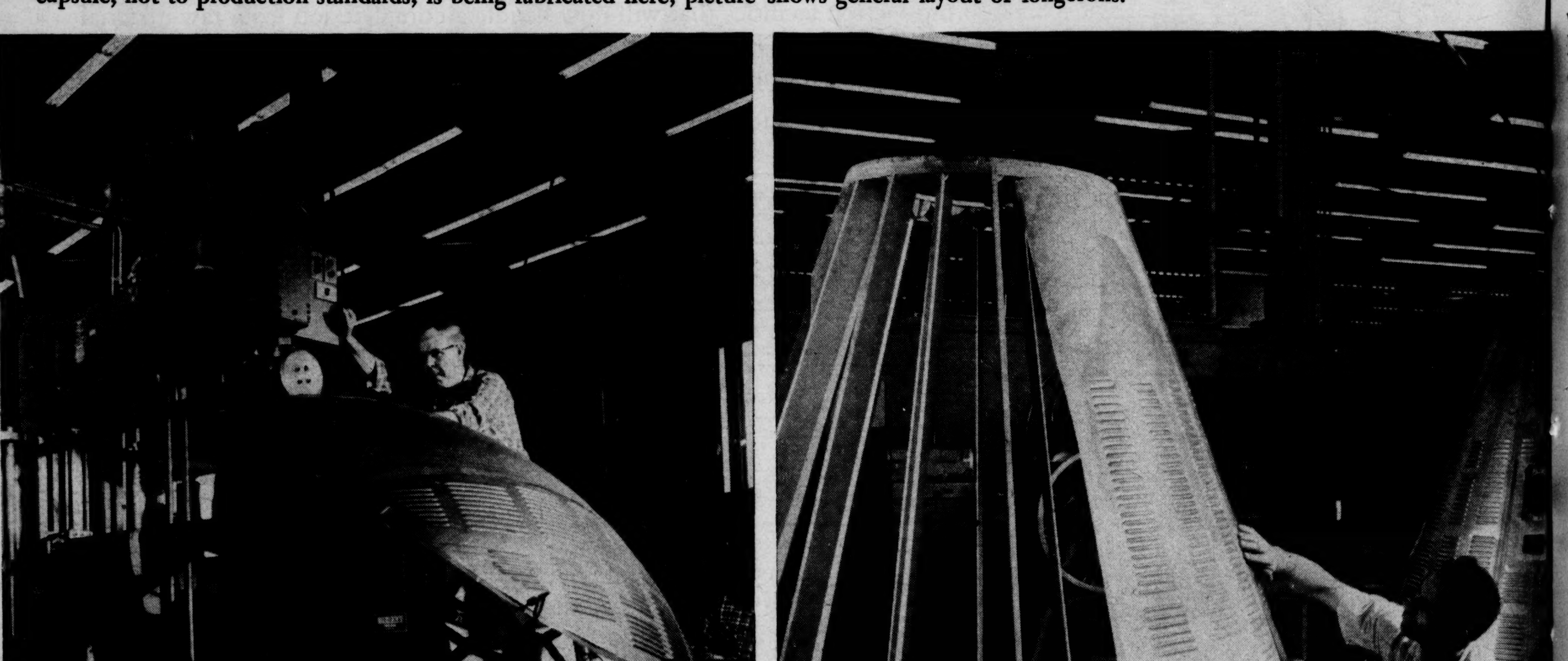
Further developments are also under investigation at Honeywell: the use of more exotic metals (stainless steel, titanium, molybdenum, columbium, tantalum, magnesium alloys); studies of new designs and materials for explosive forming dies; the use of ribbed mandrels in flow turning to produce skins with integral, internal ribs. For further information about Honeywell capabilities, or about new developments in skin fabrication, contact your nearest Honeywell representative or write Honeywell, Military Products Group, Minneapolis 8, Minn. *Sales and service offices in all principal cities of the world.*

Honeywell

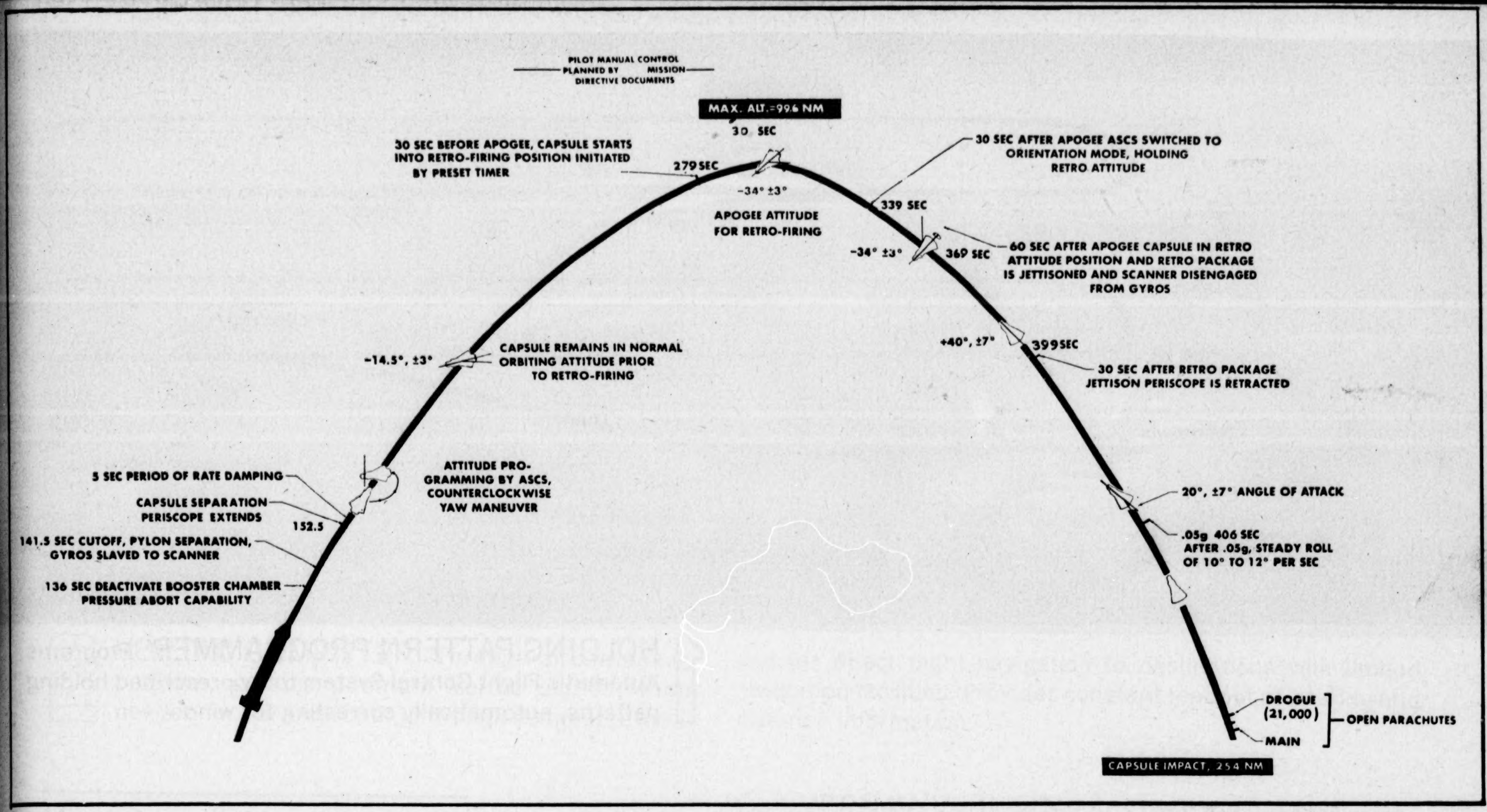
H HONEYWELL *Military Products Group*



CAPSULE construction features longerons of titanium spotwelded to outer surface of double-walled titanium pressure vessel. Early test capsule, not to production standards, is being fabricated here; picture shows general layout of longerons.



MAIN PRESSURE bulkhead behind astronaut is being seam-welded here (left) on production fixture. At right, fabricated outer walls of pressure vessel, made from beaded 0.010 titanium, are being checked prior to assembly with inner walls.


PILOT MANUAL CONTROL
PLANNED BY MISSION
DIRECTIVE DOCUMENTS
MAX. ALT.=99.6 NM
30 SEC
30 SEC BEFORE APOGEE, CAPSULE STARTS INTO RETRO-FIRING POSITION INITIATED BY PRESET TIMER
279 SEC
-34° ±3°
APOGEE ATTITUDE FOR RETRO-FIRING
30 SEC AFTER APOGEE ASCS SWITCHED TO ORIENTATION MODE, HOLDING RETRO ATTITUDE
339 SEC
-34° ±3°
369 SEC
60 SEC AFTER APOGEE CAPSULE IN RETRO ATTITUDE POSITION AND RETRO PACKAGE IS JETTISONED AND SCANNER DISENGAGED FROM GYROS
-14.5°, ±3°
CAPSULE REMAINS IN NORMAL ORBITING ATTITUDE PRIOR TO RETRO-FIRING
+40°, ±7°
399 SEC
30 SEC AFTER RETRO PACKAGE JETTISON PERISCOPE IS RETRACTED
5 SEC PERIOD OF RATE DAMPING
ATTITUDE PROGRAMMING BY ASCS, COUNTERCLOCKWISE YAW MANEUVER
CAPSULE SEPARATION PERISCOPE EXTENDS
152.5
141.5 SEC CUTOFF, PYLON SEPARATION, GYROS SLAVED TO SCANNER
136 SEC DEACTIVATE BOOSTER CHAMBER PRESSURE ABORT CAPABILITY
20°, ±7° ANGLE OF ATTACK
.05g 406 SEC
AFTER .05g, STEADY ROLL OF 10° TO 12° PER SEC
DROGUE (21,000)
MAIN
OPEN PARACHUTES
CAPSULE IMPACT, 254 NM

TRAJECTORY of MR-3 launching of Capsule 7 carrying Astronaut Shepard shows basic changes in orientation of capsule during flight, sequence of operations, and peak performance. Data is from first reduction of telemetered information.

crew stations and will be used as trainers for Project Apollo, as Apollo A earth-orbiting vehicles.

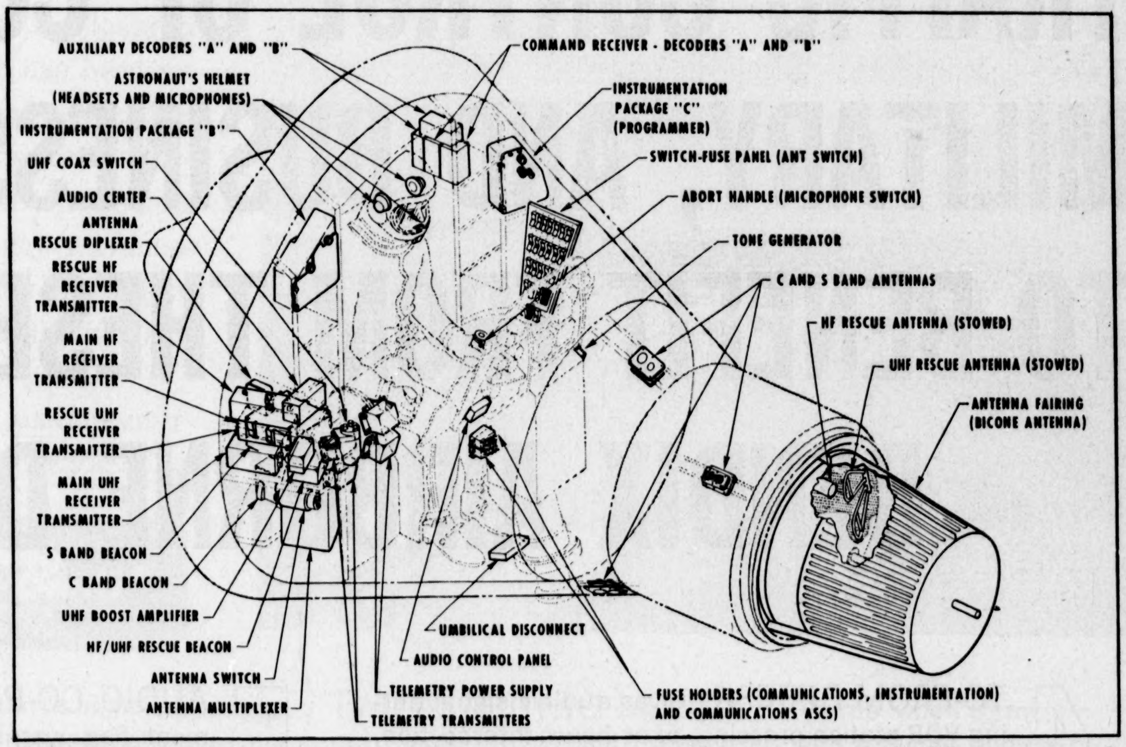
Basic geometry of the capsule was developed from simple re-entry shapes by scientists of the National Advisory Committee for Aeronautics (AW Sept. 21, 1959, p. 52). Specifications were written tightly around this layout, and McDonnell's basic capsule form varied only in detail from the original plan.

Major design restrictions on the Mercury capsule were imposed by the severe weight limitations at launch and the tremendous heat inputs during re-entry. Available Redstone and Atlas boosters are limited to about one ton of payload for ballistic and orbital flights, respectively, so that the total weight of the capsule and its systems had to be held closely to the 2,000-lb. mark. The most severe heating condition will occur during re-entry from orbital flights; ballistic test flights will be less demanding.

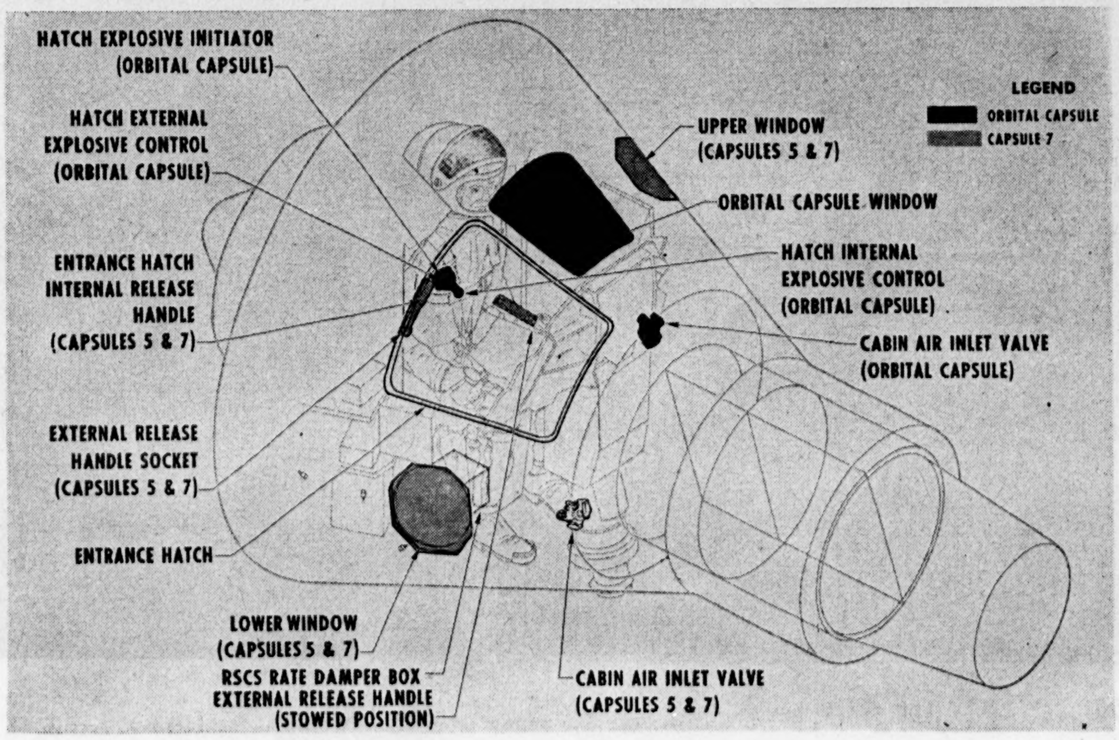
Coupled to these two major factors in determination of the Mercury capsule design were hundreds of detailed points, many of them never applicable before, which were to become major controlling effects.

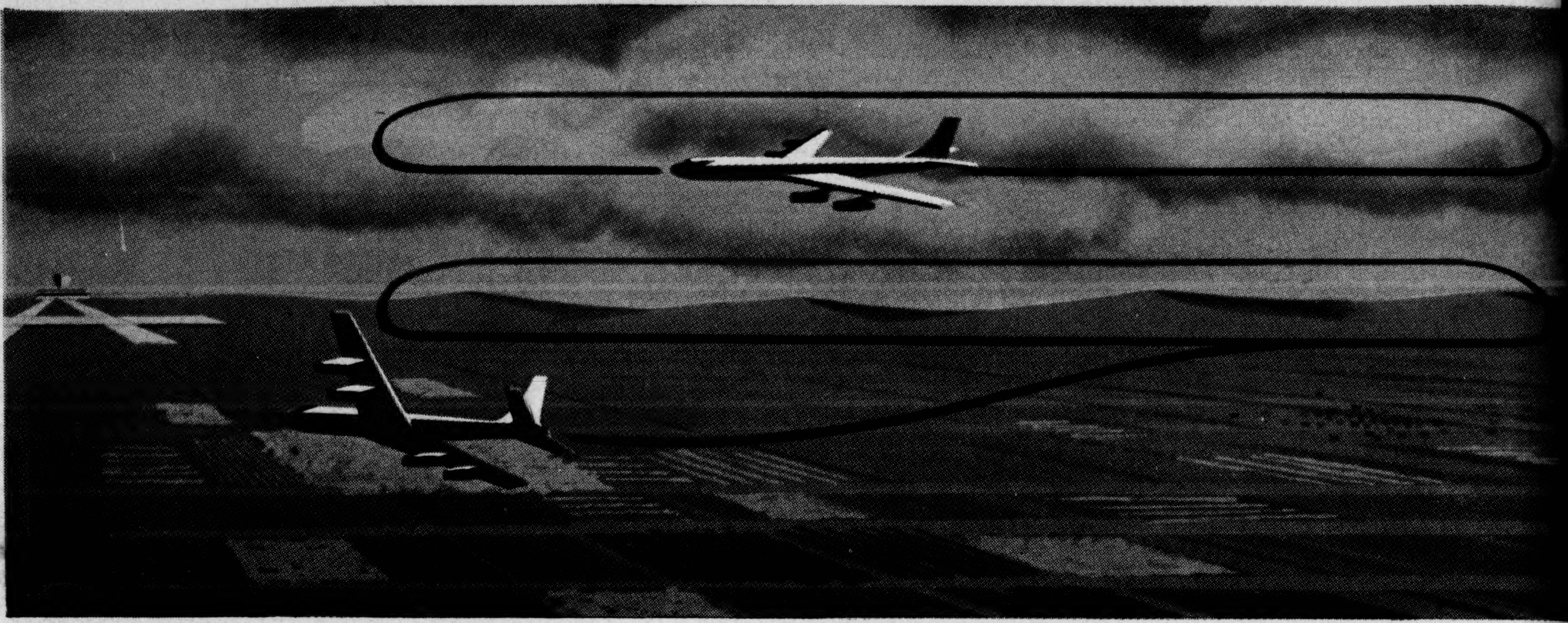
These all finally filtered down into a design of a manned space capsule measuring 74 in. diameter at the widest part of the base, and 108 in. high. It is shaped like a truncated cone topped by a short cylinder of low fineness ratio and retopped by a shorter truncated cone. The first cone contains the man and his supporting systems; the cylinder contains the landing chute, and the little cone is the antenna can.

Straddling the antenna can is a trusswork tower which carries two solid-propellant rockets: an escape rocket, with three canted nozzles, which propels the


AUXILIARY DECODERS "A" AND "B"
ASTRONAUT'S HELMET (HEADSETS AND MICROPHONES)
INSTRUMENTATION PACKAGE "B"
UHF COAX SWITCH
AUDIO CENTER
ANTENNA RESCUE DIPLEXER
RESCUE HF RECEIVER TRANSMITTER
MAIN HF RECEIVER TRANSMITTER
RESCUE UHF RECEIVER TRANSMITTER
MAIN UHF RECEIVER TRANSMITTER
S BAND BEACON
C BAND BEACON
UHF BOOST AMPLIFIER
HF/UHF RESCUE BEACON
ANTENNA SWITCH
ANTENNA MULTIPLEXER
COMMAND RECEIVER - DECODERS "A" AND "B"
INSTRUMENTATION PACKAGE "C" (PROGRAMMER)
SWITCH-FUSE PANEL (ANT SWITCH)
ABORT HANDLE (MICROPHONE SWITCH)
TONE GENERATOR
C AND S BAND ANTENNAS
HF RESCUE ANTENNA (STOWED)
UHF RESCUE ANTENNA (STOWED)
ANTENNA FAIRING (BICONE ANTENNA)
UMBILICAL DISCONNECT
AUDIO CONTROL PANEL
TELEMETRY POWER SUPPLY
TELEMETRY TRANSMITTERS
FUSE HOLDERS (COMMUNICATIONS, INSTRUMENTATION) AND COMMUNICATIONS ASCS)

COMMUNICATIONS system components are shown in this cutaway of the Mercury capsule (top). Window arrangement for ballistic and orbital flights is shown bottom.


HATCH EXPLOSIVE INITIATOR (ORBITAL CAPSULE)
HATCH EXTERNAL EXPLOSIVE CONTROL (ORBITAL CAPSULE)
LEGEND
ORBITAL CAPSULE
CAPSULE 7
UPPER WINDOW (CAPSULES 5 & 7)
ORBITAL CAPSULE WINDOW
ENTRANCE HATCH INTERNAL RELEASE HANDLE (CAPSULES 5 & 7)
HATCH INTERNAL EXPLOSIVE CONTROL (ORBITAL CAPSULE)
CABIN AIR INLET VALVE (ORBITAL CAPSULE)
EXTERNAL RELEASE HANDLE SOCKET (CAPSULES 5 & 7)
ENTRANCE HATCH
LOWER WINDOW (CAPSULES 5 & 7)
RSCS RATE DAMPER BOX
EXTERNAL RELEASE HANDLE (STOWED POSITION)
CABIN AIR INLET VALVE (CAPSULES 5 & 7)

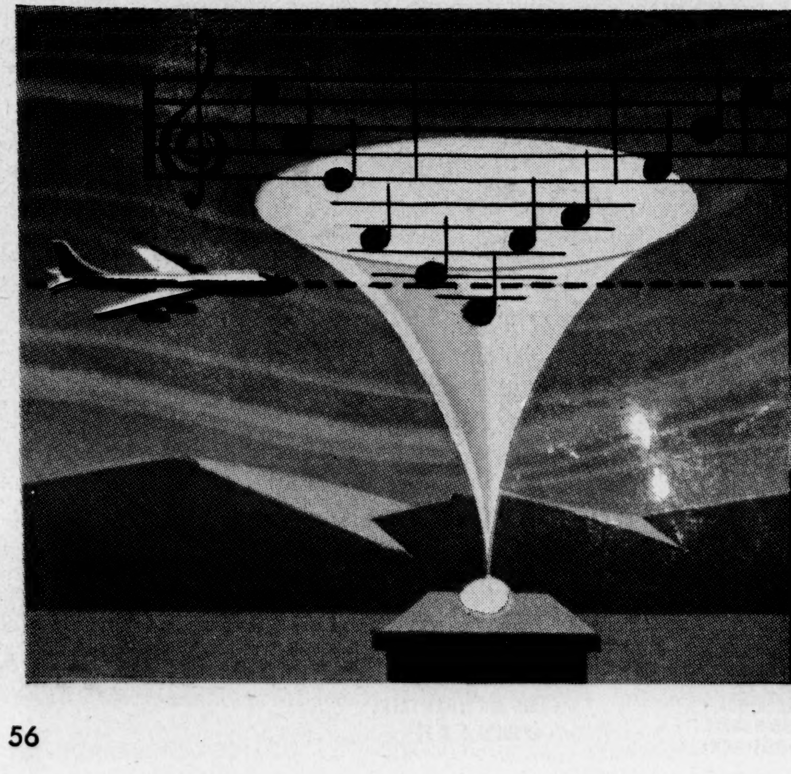


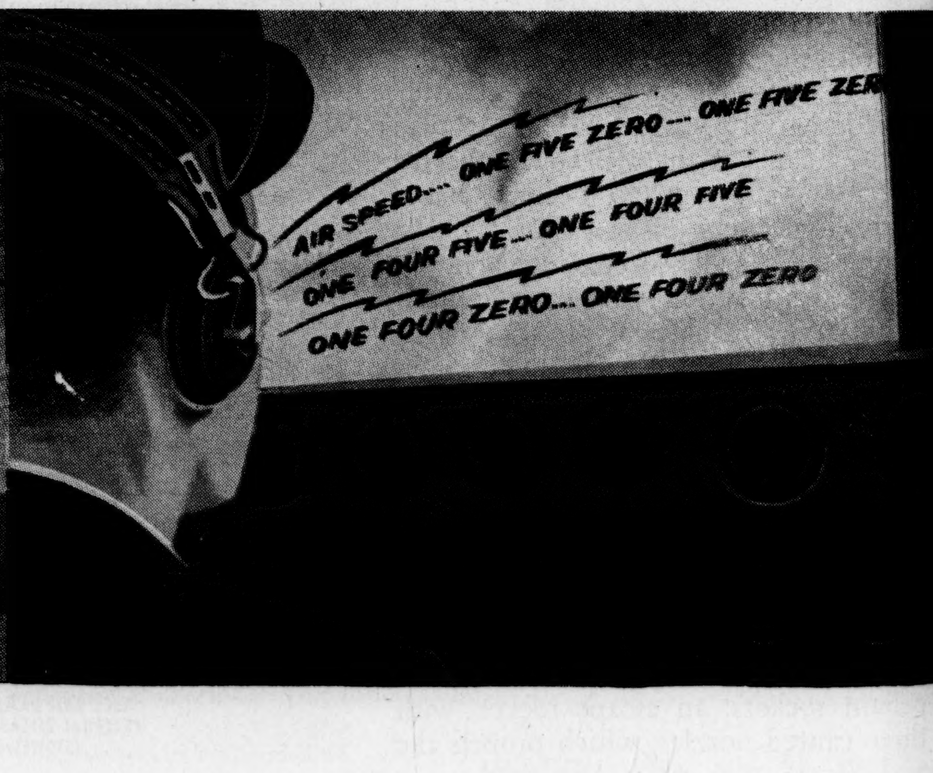
1 HOLDING PATTERN PROGRAMMER: Programs Automatic Flight Control System to fly prescribed holding patterns, automatically correcting for wind.

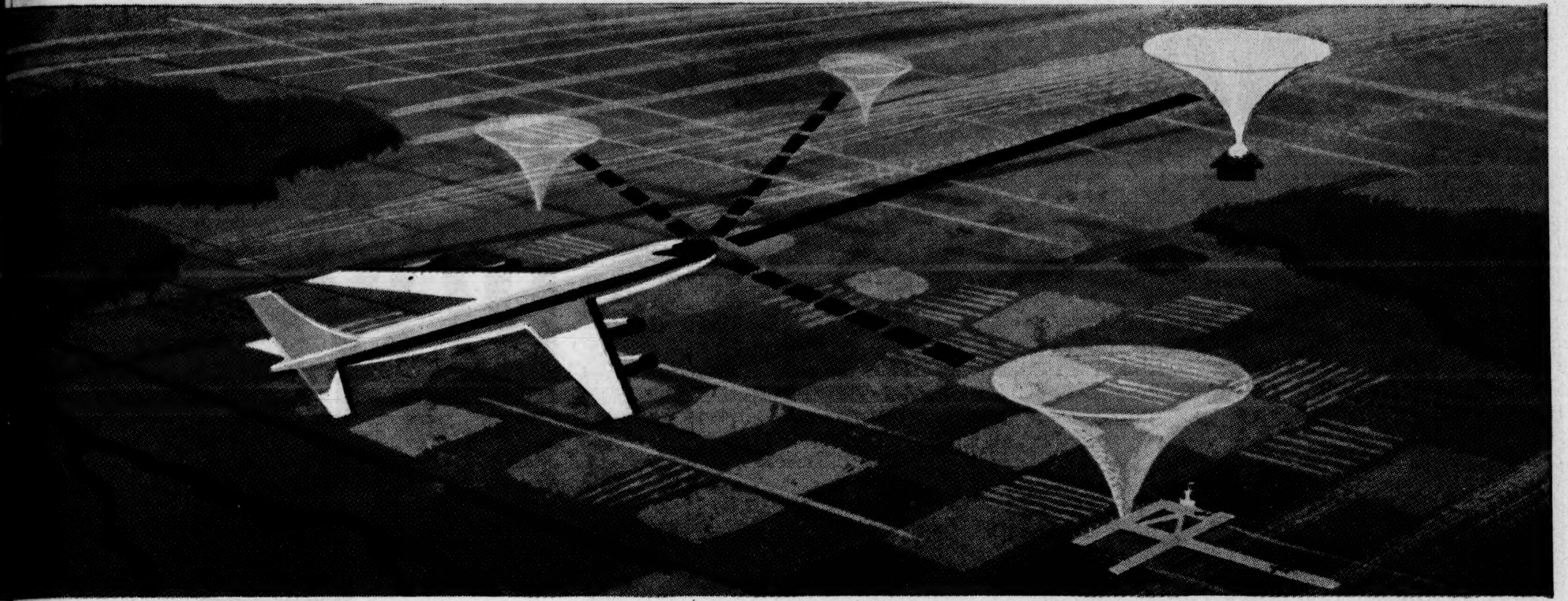
TRAFFIC CONTROL OF COMMERCIAL, MILITARY, AND BUSINESS AIRCRAFT TO BENEFIT FROM THESE 7 MODERN BENDIX AIRBORNE DEVICES

4 TO-FROM BEEPER: Gives audible signal during VOR station crossing, or at beam intersection, relieving pilot of tiring instrument concentration.

5 AUDIO CO-PILOT: An experiment in converting instrument flag warnings and selected flight data to audible signals (e.g.: calling out approach and take-off airspeeds).




AIR SPEED... ONE FIVE ZERO... ONE FIVE ZER
ONE FOUR FIVE... ONE FOUR FIVE
ONE FOUR ZERO... ONE FOUR ZERO



2 VORTAC COMPUTER: Through airborne computation, creates phantom Vortac station where needed for parallel routing through congested areas and for direct flight navigation to destinations with limited navigation facilities. Provides constant readout of bearing and distance information.

Knowmanship in Action

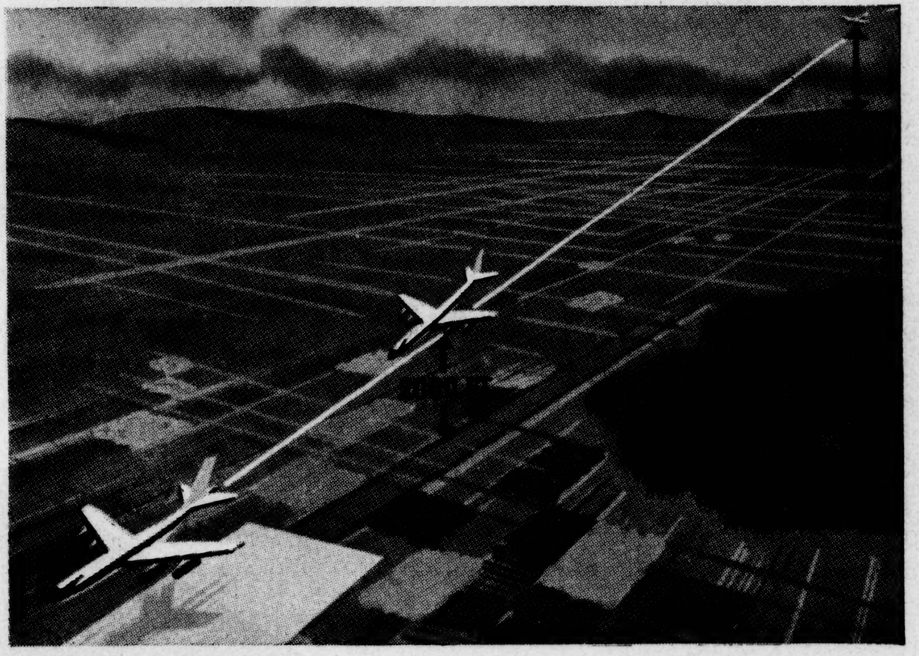
Since introducing the "earth inductor" compass in aviation's early days, Eclipse-Pioneer has been responsible for a wide array of control and navigation equipment that has anticipated aviation's ever-growing, ever-changing needs. All seven devices shown on these pages are important new advances keyed to jet-age problems and ready to aid in relieving the cockpit pressures of navigation and traffic control.

TECHNICAL KNOWLEDGE + EXPERIENCED MANAGEMENT + SPECIALIZED CRAFTSMANSHIP = **KNOWMANSHIP**

For further information, write . . .
Eclipse-Pioneer Division
TETERBORO, N. J.

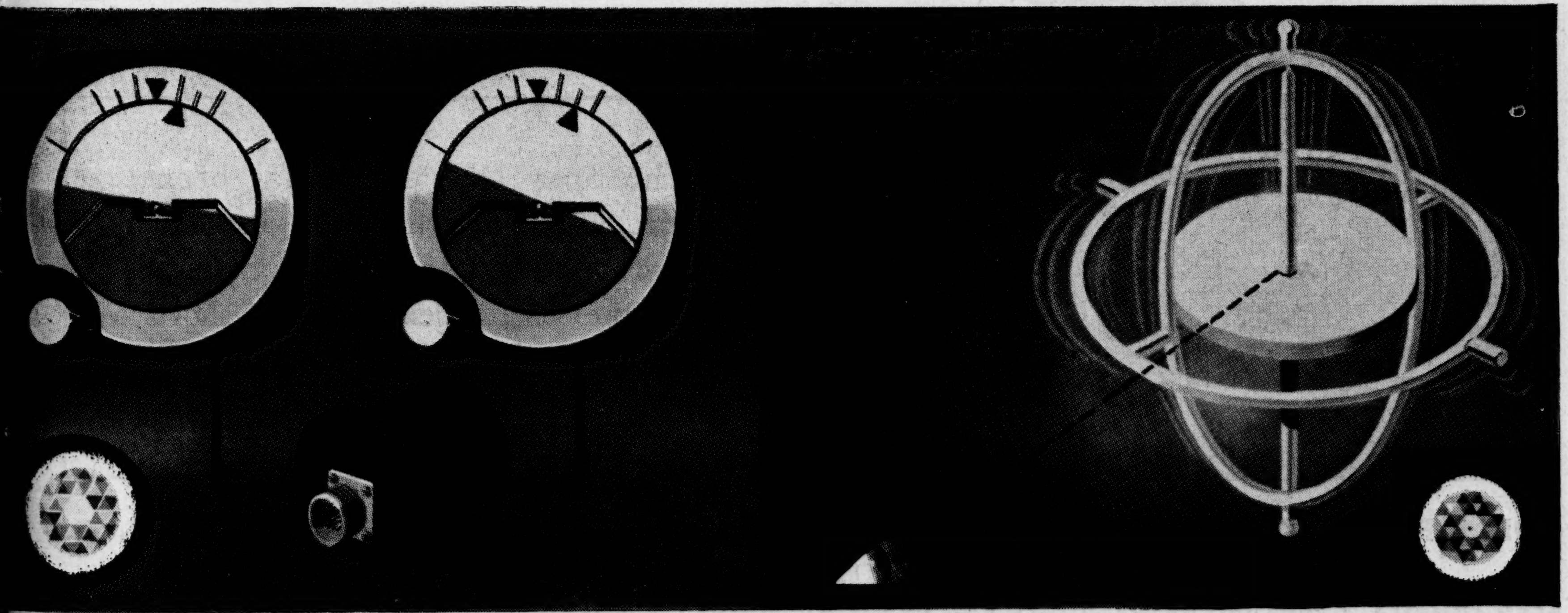
THE Bendix CORPORATION

3 VERNAV (Vertical Navigator): Automatically computes and flies optimum climb or descent path to any preselected point in altitude.

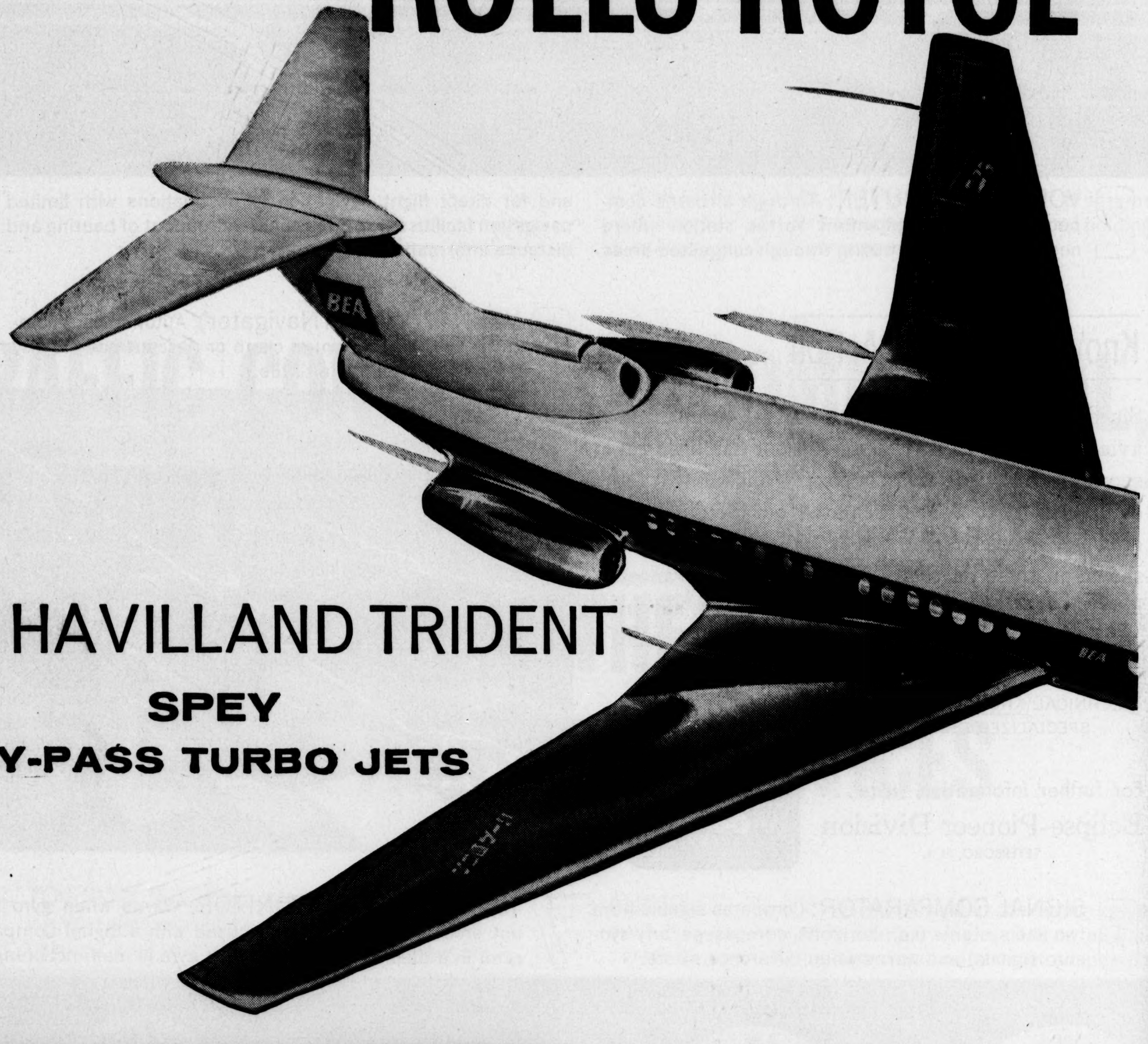


6 SIGNAL COMPARATOR: Compares signals from two like systems (i.e.: horizons, compasses, any synchro signals) and warns when difference exists.

7 TWO-AXIS GYRO MONITOR: Warns when gyro is not erected to vertical. When used with a Signal Comparator in a dual system, tells which gyro is malfunctioning.



POWERED BY ROLLS-ROYCE



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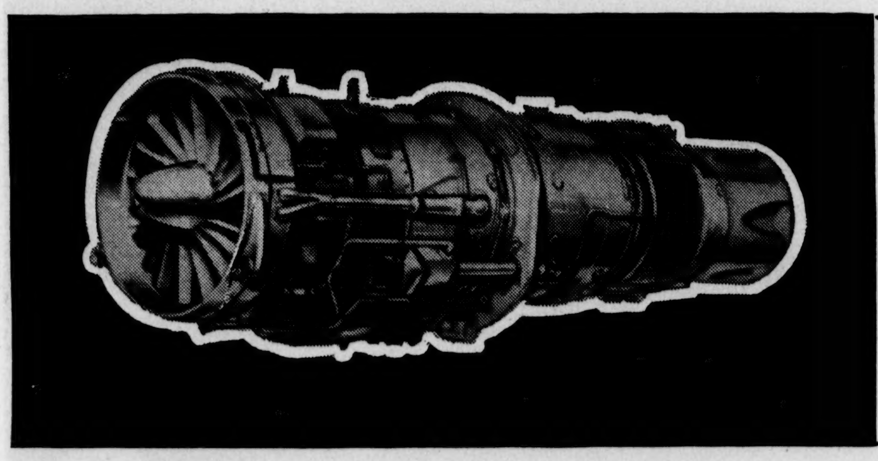
BY-PASS TURBO JETS



The Spey by-pass jet has been specifically designed to give the best possible operating economics for the second generation of short to medium range jet transports.

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entire capsule in the event of an emergency, and the tower jettison rocket which removes the tower and the escape rocket.

At the base of the cone is the heat shield: beryllium for ballistic flights, and an ablating fiberglass type for orbital runs. Strapped to the base of the capsule is a package containing three posigrade (accelerating) rockets and three retrograde (decelerating) rockets.

Inside this prosaic geometry of cone and cylinder is fitted one of the most complex collections of redundancies piled on redundancies ever conceived by engineers anywhere.

Each component on which the astronaut depends has at least one backup system. In some, such as the flight control system, there are three complete backups plus the primary. Basic design philosophy for the systems was automatic operation, so that in the final analysis the astronaut could just lie there and do nothing. But it was also a requirement that the systems could be operated manually by the astronaut with overrides, or by command from the ground. Thus safety of the system was designed at the highest reasonable level.

Weight, strength and temperature considerations decided the McDonnell engineering team in favor of titanium as the major structural material for the capsule. Design of the capsule was planned as two concentric structures: an inner pressure vessel and an outer heat shield.

The inner pressure vessel starts as trapezoidal sheets nearly six feet long of 0.010 commercially pure titanium supplied by Titanium Metals Corp. of America. These skins are fusion-welded to form two cones: one, which is the inner wall of the pressure vessel, is made of flat-rolled titanium; the other is the beaded titanium outer wall of the pressure vessel. These two cones, fabricated and tested separately, are nested and spot-welded to hold position while the final seam-welding is done. The cones are joined by circumferential seam welds between rows of beading and longitudinal welds adjacent to the beads.

Bending, tension and compression loads on the capsules are taken by a framework of commercially pure titanium stringers—hat sections—which are attached to the double-walled pressure vessel by spot-welding. A layer of Johns-Manville Thermoflex ceramic-fiber insulation is wrapped around the pressure vessel and up to the outer faces of the hat sections. Tops of the hat sections are insulated with a thin strip of J-M Min-K 1301.

Outer heat shield is a series of beaded "shingles," slabs of Haynes Stellite Co.'s alloy R-41 or—in special instances—beryllium, which are fastened to the stringers with bolts, washers and screws. They are thermally insulated by the Min-K 1301 from the structure.

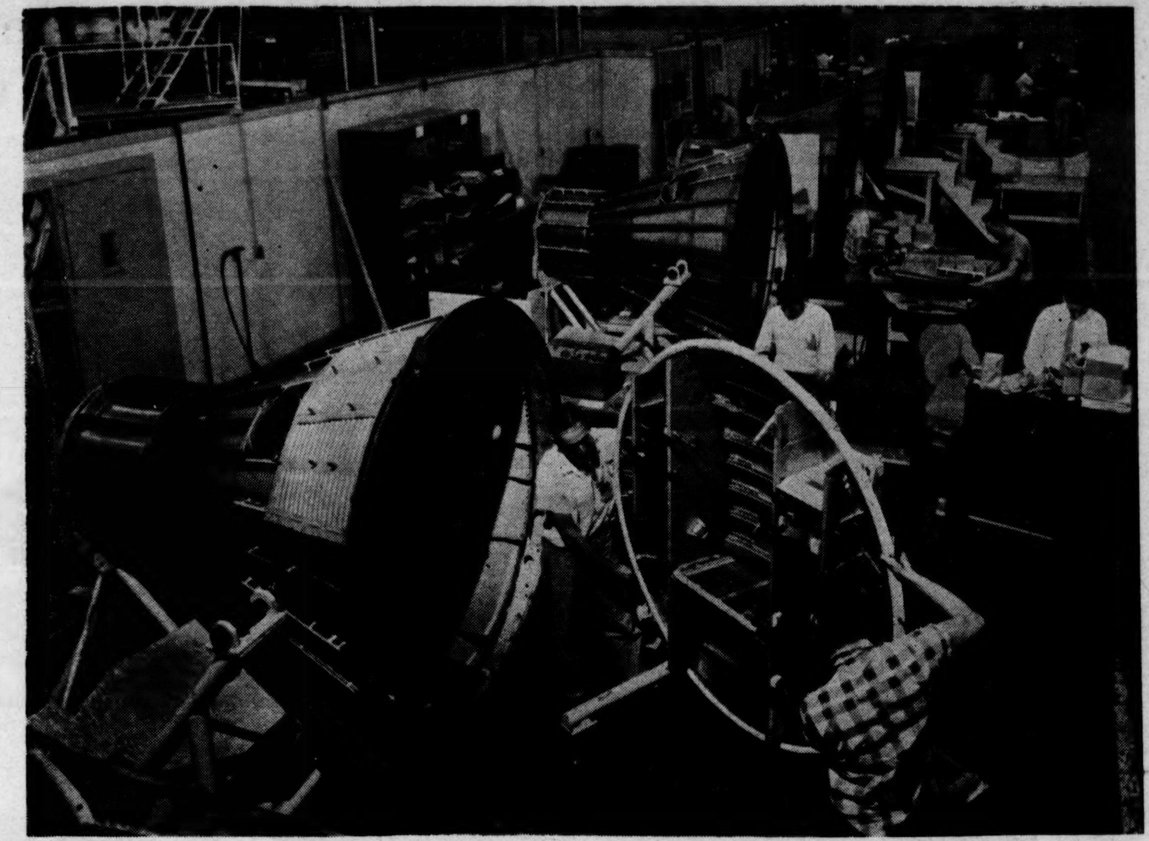
Forward and rear pressure bulkheads are also formed from welded titanium stock in similar manner.

Key to the fabrication of the strong, weight-limited capsule was the welding technique developed by McDonnell manufacturing engineers. Fusion welding of titanium traditionally is done in a gas chamber which surrounds the entire welding procedure with an inert atmosphere.

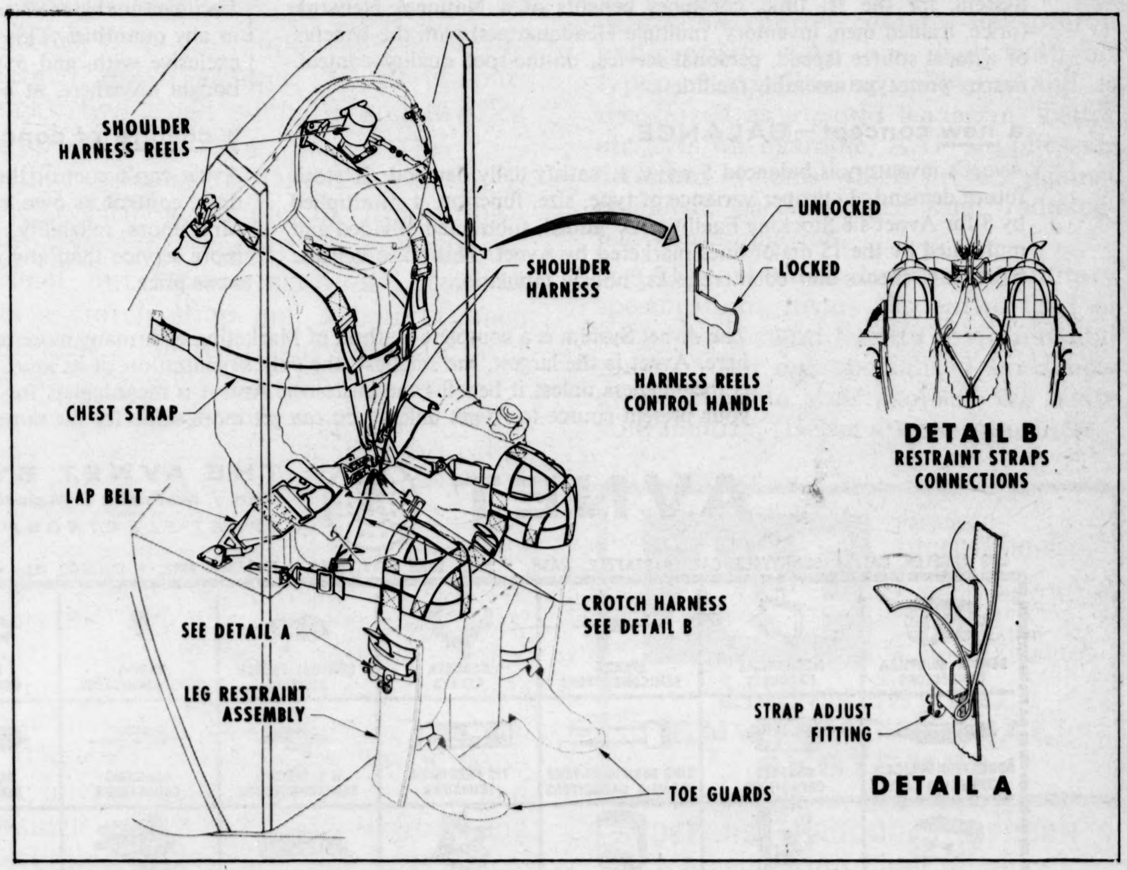
The engineers decided that was out and, after long hours, came up with the final production technique. They designed and developed new fixtures, so that all fusion welds were done with tungsten-arc equipment, shielded by an inert gas on both sides of the weld plus trailing and backup shields. Chilling of the welded area was also provided to control temperature of the material. Results of this technique have to be seen to be appreciated; the weld looks like a slightly brighter, dead-straight insert of metal set flush between the two titanium skin sheets.

Seam and spot welds were made in the open, on standard production equipment.

For Shepard's flight in the MR-3 capsule, special beryllium shingles were used on a portion of the upper section



ASSEMBLY sequence of capsule shows double-walled structure, external shingles, and positioning of rear bulkhead which supports astronaut's couch and systems.



ASTRONAUT'S restraint system features innovations in knee and crotch strapping.

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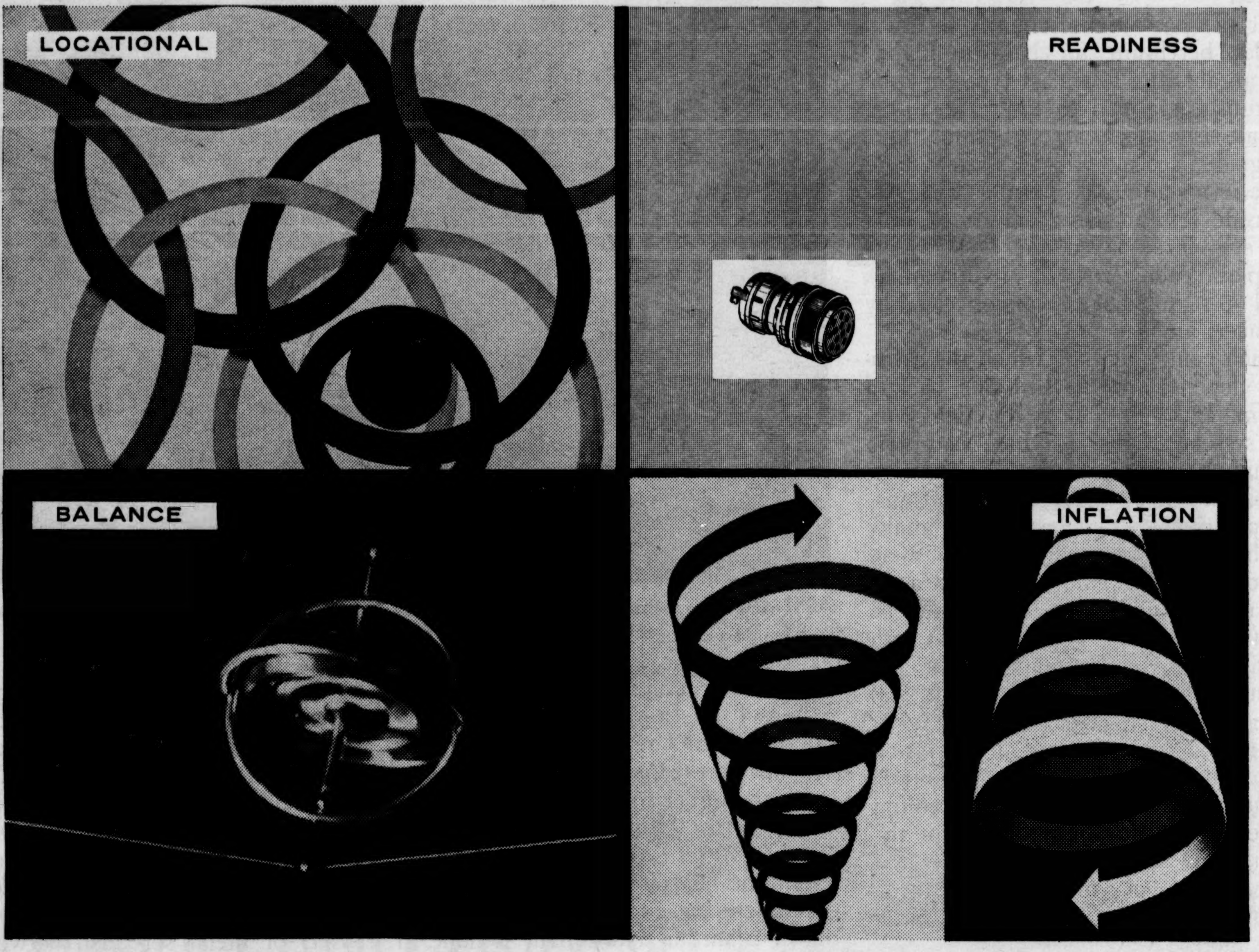
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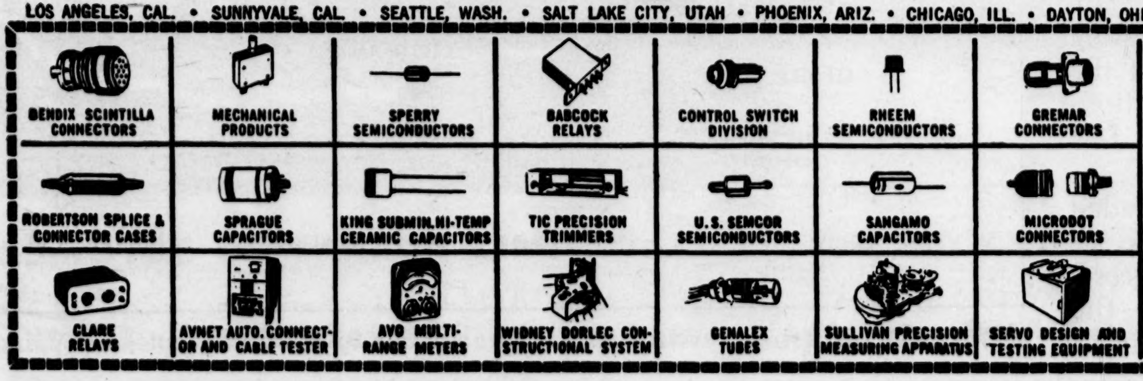
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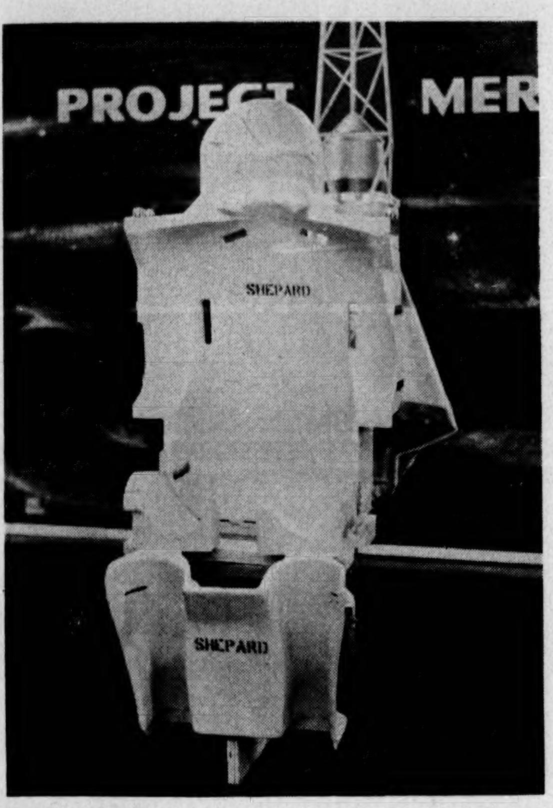


SHEPARD'S couch shows extent of supports for helmet, thighs and legs.

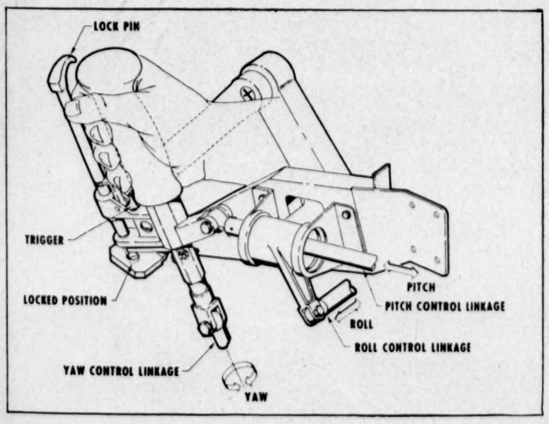
of the capsule. The shingles and the 350-lb. beryllium heat sink used for the flight were fabricated by Brush Beryllium Co.

Capsules assigned to orbital shots, which will impose greater heating during re-entry, will use an ablating fiberglass shield furnished by Cincinnati Testing Laboratory.

Quality control of manufacturing, usually a major effort in the aircraft industry, was extended by McDonnell to guarantee as far as possible the reliability of the capsule and its systems. The company assigned about 125 technicians to the job, which averaged out to about one quality control man per six production workers.

Besides checking its own and subcontractors' performance to specification, McDonnell's quality control personnel made continuing audits of design, methods, planning, tooling, inspection techniques and anything else that would have bearing on the final quality of the product.

Man has two fundamental roles in the Mercury shots: scientific observer, and systems backup. Everything in the capsule design was developed to aid the astronaut in both those roles as far as possible.



THREE-AXIS hand controller orients capsule.

First consideration was that all seven on the current astronaut roster, and any to follow, would be different sizes and shapes. Even though the astronauts are all about the same height, for example, the lengths of individual limbs, shapes of the bodies, positions of joints all vary considerably from man to man.

The first basic decision was that all personal gear would be fitted specifically to each man. Fortunately, one of the big pieces of work had been largely accomplished by B. F. Goodrich, in its full-pressure suit for the Navy. This garment, modified and adapted to the special requirements of the Mercury shots, became the astronauts' suit.

Basic position for the astronaut—back and lower legs in parallel planes—was chosen to minimize the hydrostatic head against which the heart would have to pump during G-loading. With this supine position—or upright position, depending on the axes of reference—fixed, the next design item was the couch and the restraint system.

Fixed design point for the couch and restraint system was the location of the astronauts' eyes in the capsule. Position of the instruments, particularly the periscope, meant that the eyes could not vary far from an optimum position. That position was the controlling point for the layout of the couch.

Individually Tailored

Couches are individually tailored to each astronaut. They consist of a honeycomb sandwich shield, which is common to all couches, and an individually tailored padded fiberglass shell.

The honeycomb material is crushable aluminum, and the shell is a polyester resin-reinforced glass fabric laminate.

Final design combines a couch which extends from the upper portion of the helmet down around the lower buttocks; two thigh supports and two leg supports.

The expected restraint strap system is used, with a couple of innovations. Shoulder and lap straps are conventional, but there is additional restraint by a crotch strap and a pair of knee retainers. The astronaut's feet are held in place by a toe plate on the floor.

Two basic systems support the astronaut's environment, one for the cabin and one for his suit. Both supply 100% oxygen at a control pressure of 5 psia.

Design criteria and system schematic were specified by McDonnell, and AiResearch Mfg. Co. Division of the Garrett Corp. did the design of components, developed and tested the units and fabricated the systems.

Designers specified the lowest possible internal pressure in the capsule, and a single gas for both pressurization and breathing. Heat rejection was calculated as 400 Btu./hr. for a typical astro-

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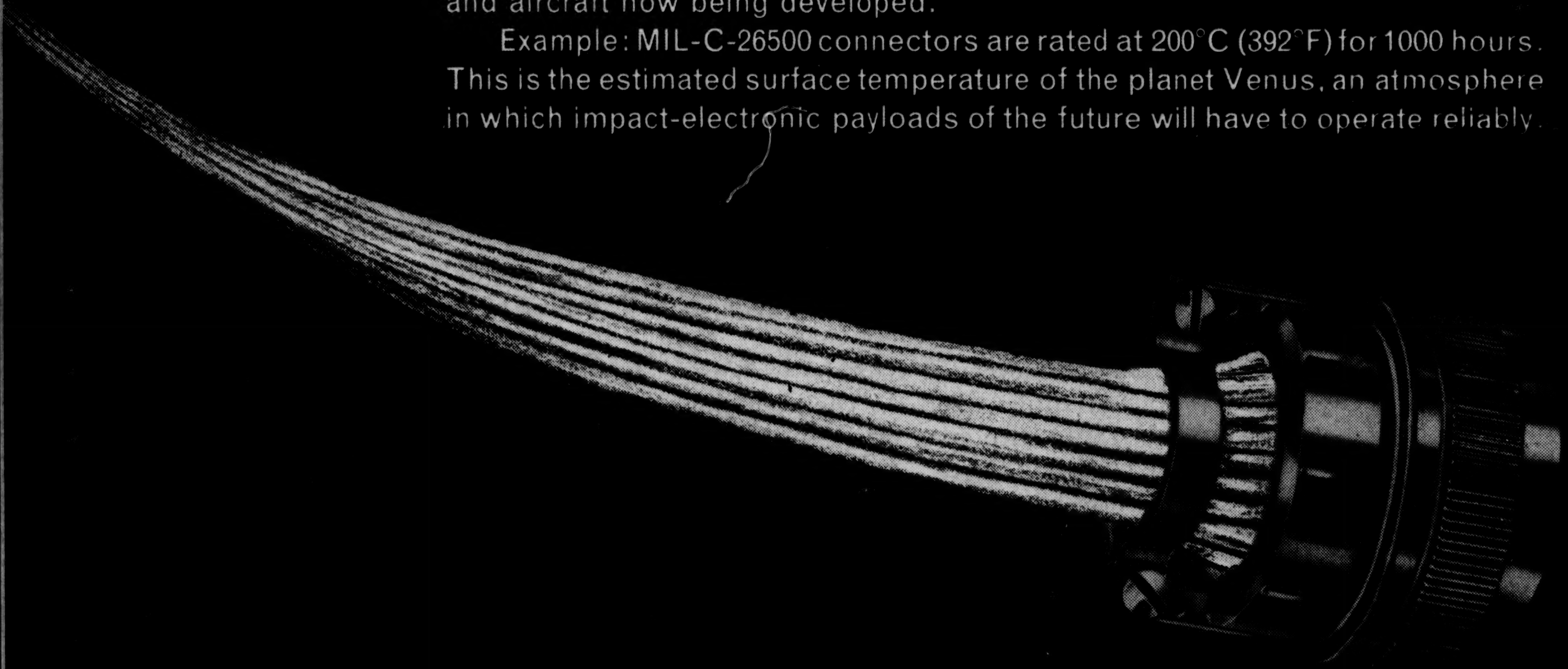

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naut. His oxygen consumption was specified at 500 cc./min. under standard temperature and pressure; carbon dioxide production was calculated at 2.6 lb./day and perspiration and water at 6 lb./day. Cabin temperature was to be held to between 80 and 100F.

In operation, the system starts with an oxygen purge of the capsule at sea-level pressure, which is reduced to 5 psia. as altitude increases. Purging is done with a separate oxygen bottle and reducers.

Main oxygen system has two bottles which hold four pounds of liquid oxygen at 7,500 psi. pressure. They feed through parallel reducers which drop the pressure to 100 psia. upstream of a demand regulator; and then pressure is further reduced to 5 psia. in the suit and cabin circuits.

Oxygen enters the suit at a waist connection, at a temperature of 96F and a relative humidity of 58%. It circulates upward and is breathed by the astronaut. Discharge gas is returned through a circuit which contains a solids trap, an odor absorber, carbon-dioxide absorber, heat exchanger and water separator, and then returns to the suit along with makeup oxygen.

Cabin pressure is sensed and maintained by an aneroid valve; but if cabin pressure is lost, the suit pressurizes because of the redundant circuit. During descent, a cabin relief valve decreases the pressure change and allows a buildup in environmental pressure until, after landing, snorkel valves open and allow ambient sea-level air into the cabin.

Instruments and Controls

Directly ahead of the astronaut is the large center section of his three-piece instrument panel. At the top is an attitude indicator which shows individual roll, pitch and yaw attitudes and a combined presentation. Beneath it at the left is the Earth Path Indicator, a presentation which continually shows the astronaut his present position projected down to the surface of the earth, and the predicted landing point should he initiate re-entry at that instant. Both the EPI and attitude indicator are made by Minneapolis-Honeywell Military Products Group.

To the right of the EPI is a satellite clock, which gives readout of real time, time from launch, and time to retrograde. The actual time for initiating the retrograde action is set into the clock by command from the ground tracking and computing data; a five-minute warning light gives the astronaut that amount of time to prepare for re-entry action. Time to retrograde is in effect a countdown for firing the retrograde rockets.

Bottom portion of the panel is the Perkin-Elmer periscope for direct visual

TALL

in telemetry systems management

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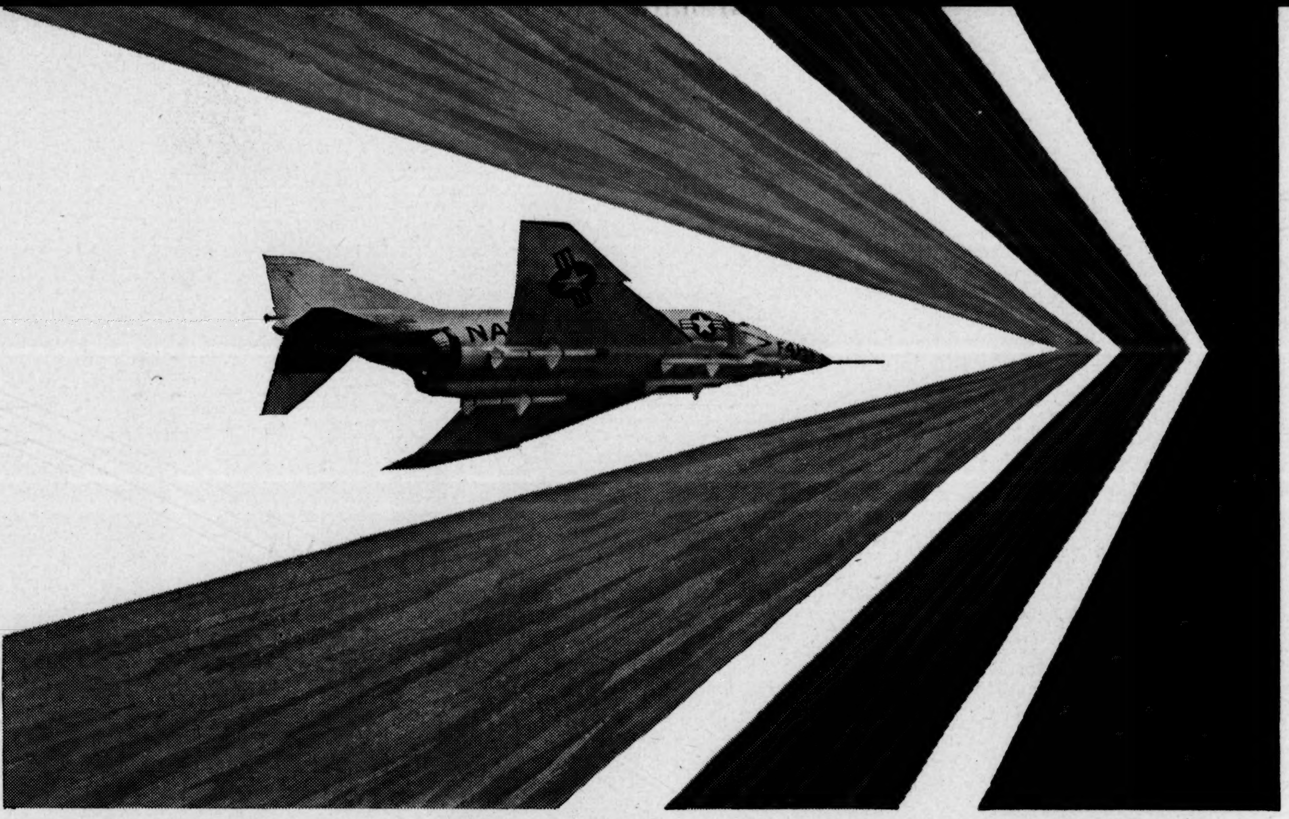

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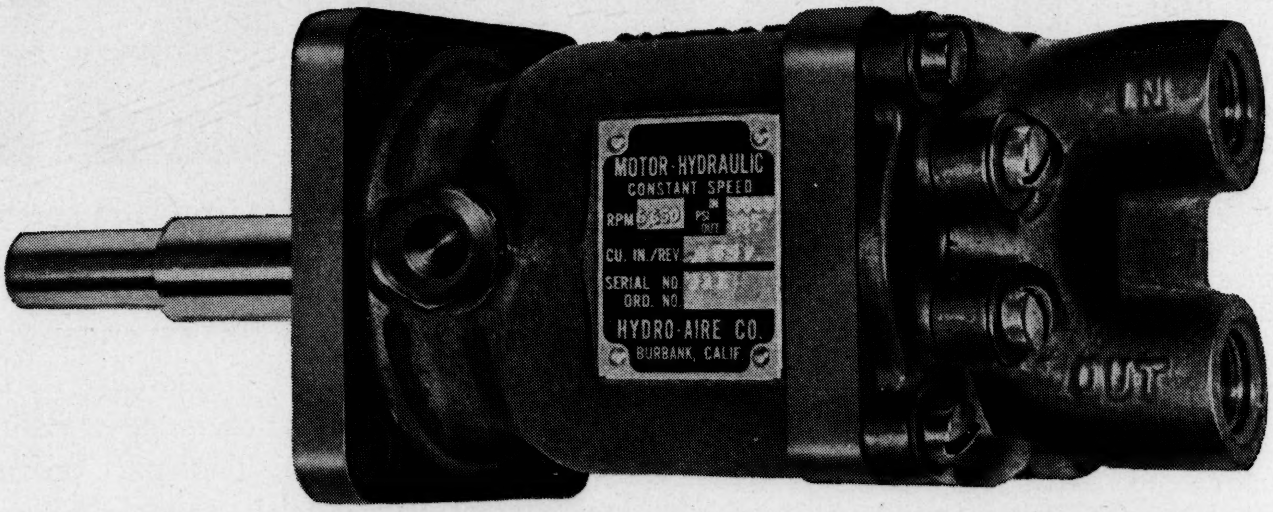

You can bet McDonnell had good reasons to choose Hydro-Aire hydraulic motors for this advanced application. The first is reliability resulting from optimum design simplicity and now proved both in flight and in extensive environmental tests. Others are reflected in the characteristics of this typical model, 68-193-079. Displacement: 0.0787 cu. in. per rev. Torque: 30.4 in. lbs. at 2800 PSI inlet to outlet pressure differential and 12,000 rpm. Hp/Wt. ratio: 3.92:1. Life: 1200 hours. Write now for data sheets on available models and/or a prompt quote on your specifications.

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observation of the earth for navigational purposes.

A vertical section of the center panel mounts, from top to bottom, an accelerometer, a control fuel-quantity gage, a rate of descent indicator and an altimeter.

Next left is a vertical panel containing lights and manual control system initiators for all of the critical operations during take-off and landing. A vertical series of indicator lights shows green in sequence as the launching and re-entry cycle proceeds normally. If a light shows red, the astronaut activates the adjacent control that allows him to operate the system manually, and then gets the green light.

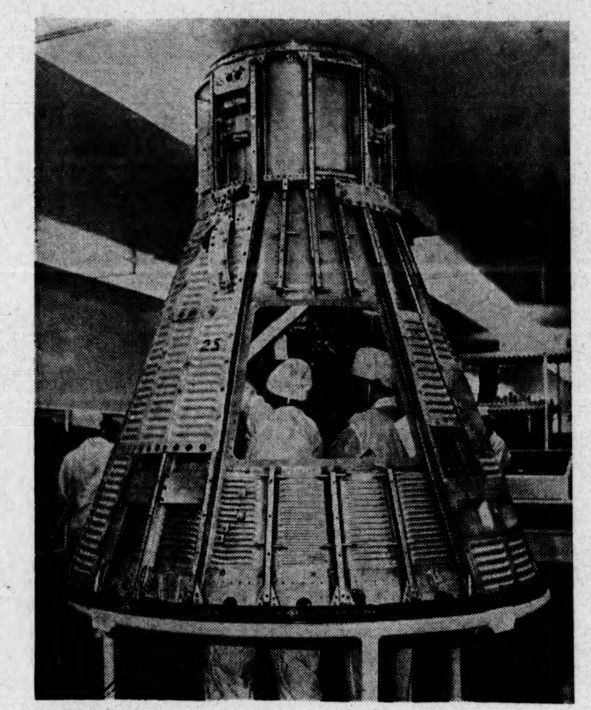
Final panel section at the left handles subsystems, including selection of the mode of operation for automatic stabilization and control system (ASCS), cabin lights, rescue aids, and the like. It also mounts four handles which activate the manual control system for attitude control of the capsule, individually by channels for roll, yaw and pitch.

Directly to the right of the main panel is an upper panel which mounts gages metering the life support system. Below these is another section which handles the electrical services, and below these is the communications panel. To the right is a series of auxiliary warning lights covering the suit and the cabin, and at the extreme right is a panel with six main circuit breakers.

At the astronaut's right shoulder is a chest parachute pack, and at his left shoulder is his survival kit. His right hand holds a three-axis control stick, actuated simply by rotating motions of the wrist, and his left hand holds the "chicken switch," the unit which actuates the abort sequence.

A flashlight for emergency lighting is mounted on the upper portion of the left-hand capsule wall. Next to it is the "swizzle stick," a hooked lever about a foot long which extends the astronaut's reach if his suit pressurizes and restricts his normal arm motions. He still has to reach the stick, though.

Two circular portholes, one on each side, were in the early capsules including Shepard's MR-3 shot. Later orbital capsule will have a "picture window," suggested by the astronauts, on the centerline of the capsule, forward and overhead. A retractable red filter is mounted below the window, a rear-view mirror at the front of it, and a hinged two-piece shield swings in to cover the window during extreme flight conditions. All windows are made of Vicor, a high-temperature quartz glass developed by Corning Glass Works.



SYSTEMS installation in "superclean" room.

Automatic pilot for the capsule is a different kind of system based on infrared sensing of the horizon and standard gyro use. System was outlined by McDonnell engineers, then developed by Minneapolis-Honeywell, incorporating infrared sensors developed by Barnes Engineering Co. and a reaction-control system developed by Bell Aerosystems Co.

First job of the ASCS system is to detect any tendency to tumble after separation of the capsule. This is sensed and corrected by reaction controls automatically. A few seconds after positive separation and damping, the control system is programed to orient the capsule with the heat shield first along the trajectory.

At this point in Shepard's flight, he actuated pitch, yaw and roll manual channels respectively to check operation of the control system.

Next job of the ASCS is to pitch up the heat-shield end of the capsule for firing of the retrograde rockets to begin the re-entry. After they are fired, another command pitches the capsule down for the actual re-entry.

When initial deceleration in re-entry has reached 0.05g, an accelerometer sends a signal that shuts off the rate gyros and starts the capsule rolling at about two revolutions per minute, to distribute heat input evenly.

Bell's reaction control system is built up from 18 thrust chambers using hydrogen peroxide as propellant. Forced over a catalyst, the peroxide decomposes into steam and oxygen which produces the exhaust jet. System uses helium at 450 psi. as propellant drive. The peroxide passes through shutoff valves to control solenoids and then to the thrust chambers.

System operates either automatically or manually, with the two phases being completely separated. Automatic uses 12 thrust chambers, four for each axis, left and right. In pitch and yaw, the nozzles are mounted at the upper cylindrical portion of the capsule and are rated at 1 lb. and 24 lb. thrust. Roll nozzles are mounted at the large diameter of the capsule and give either 1-lb. or 6-lb. thrust.

In the manual system, six chambers are used. Pitch and yaw each use two chambers rated from 4 to 24 lb., one for each motion sense from the centerline. Roll axis uses two for left or right roll, rated at 1- to 6-lb. thrust each.

The entire ASCS system has four modes of operation: automatic, where the astronaut can just lie there and do nothing; rate stabilization, where the gyros sense rate changes and stabilize the system, but do not handle other phases of the operation; fly-by-wire, where pilot's stick motions are translated into electrical signals which actuate the system, and finally, complete manual, where the pilot's stick linkages directly control proportional throttle valves ahead of the thrust chambers.

Communications Systems

Collins Radio, responsible for the communications systems of the Mercury capsule, laid out two basic functional systems: flight, and rescue. Each of these had backup sets. All signals are multiplexed on a single antenna.

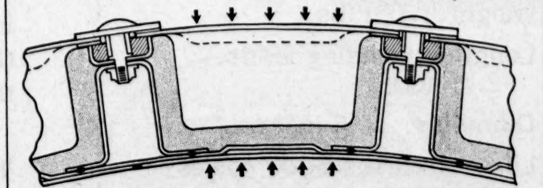
For flight communications, there are two UHF and two HF voice transmitters and receivers, two command transmitters, two telemetry systems and both C- and S-band radar tracking beacons, made by Avion, Inc.

For rescue, there is HF "Sea-Save" rescue equipment plus DF-homing gear, an HF voice transmitter and a UHF "Sarah" beacon, also with DF-homing.

Telemetry system is sub-commutated, will transmit 90 bits of data during flights. Major components of the telemetry instrumentation were developed and built by Dorsett Electronics, Inc., Beckman Instruments, Inc., and Thompson Ramo Wooldridge, Inc.

During Shepard's flight, two miniature tape recorders made by Consolidated Electrodynamics Corp.'s Datalab Division recorded voice comments, environment of the capsule and physiological data from the astronaut. His face and the instrumentation display were continuously photographed by D. B. Milliken Co. 16-mm. pulse cameras.

Power supply for the entire capsule



SECTION through shell shows construction.

Lanyard-operated switch withstands 92 G's at 2000 cps

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Spring Actuated Switch

- Type . . . 4-pole, double-throw
- Current capacity . . . 10 amps. each circuit
- Voltage drop across contacts at 10 amps., 28 v.d.c. . . . under 50 millivolts
- Weight . . . 0.5 lbs.
- Length, excluding leads . . . 2.7 inches
- Diameter . . . 1.6 inches
- Life . . . exceeds 5000 cycles minimum
- Environment . . . meets MIL-E-5272

For extremely rigorous missile environments with shattering vibration as high as 92 G's rms at 2000 cycles, Kinetics Corporation has developed a new lanyard-operated switch. Absolute reliability is assured, even when the unit is installed in locations subject to maximum acoustic vibration or white noise.

The new four-pole, double-throw switch combines the unique Kinetics contact design with a plunger and spring operating mechanism for position stability. In one current application, a lanyard attached to the ground holds the switch in one position. When the missile lifts off the pad, the lanyard is pulled, actuating the switch.

This new switch, which has been designated Type M-479-1, has just passed a severe testing program with flying colors. It was exposed to high level sinusoidal and random noise vibration tests in both axes in the normally open and closed positions without contact movement or chatter. The highest vibration level the switch has passed to date has been an equivalent 92 G's rms at 2000 cps. Testing was carried out at frequencies from 50 to 2000 cps. If required, switches of this design can be built to withstand even greater vibration.

This Kinetics switch design lends itself to a wide variety of missile applications, such as actuation upon missile launch or stage separation. It can also be used as a limit, timing, or function switch for range safety, power or instrumentation. For help with your switch requirements, write or phone Kinetics Corporation, Dept. KA-5, 410 South Cedros Avenue, Solana Beach, Calif. SKyline 5-1181.

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comes from six silver-zinc batteries made by the Eagle-Picher Co. Four of these are main batteries, with 24-v.d.c. output, and are expected to handle the requirements of the mission plus 12 hr. after landing.

If the voltage drops, automatic switching turns off the nonessential equipment and switches to a standby battery. The standby will handle one orbit and 12 hr. post-landing if necessary.

The sixth battery is an isolated unit, set off independently to handle the job of firing emergency systems manually. A switch ties the isolated unit to the standby battery at the pilot's option.

Power requirement is 30 to 35 amp. continuous with surges to 60 amp.

With toxicity of materials one of the major design criteria for everything that went into the systems, the insulation chosen for wiring was an irradiated polyethylene type, which will take one-shot exposure to temperatures as high as 800F without breakdown.

Three static inverters are used, one for the autopilot system, one for the environmental system and one standby. Heat output from the inverters, which posed a tough problem because of the lack of convection currents in weightlessness, is handled with an aluminum plate heat sink tied to the structure.

Escape Rockets

A 14-ft. trusswork tower, bolted to the top of the capsule with explosive bolts, carries an escape rocket to haul the capsule to safety in the event of an off-the-pad abort. The 50,000-lb. thrust solid-propellant rocket, developed by Grand Central Rocket Co., is a single charge in a case with three nozzles canted outward to direct their blast away from the unprotected end of the capsule.

Retrograde and posigrade rockets, three of each, are housed in a separate package held by three tension straps from the widest diameter of the capsule and pinned at the center of the package by a single explosive bolt. This and other explosive bolts are made by Winchester-Western Division of Olin Mathieson Chemical Corp.

The retrograde rockets, developed by Thiokol, are intended to slow the capsule so that re-entry begins. The posigrade rockets, developed by Atlantic Research, separate the capsule positively from the booster at about 15 fps.

Landing system was developed by Radioplane Division of Northrop Corp. Started by an aneroid signal at about 21,000 ft. altitude during re-entry, the system ejects a six-foot-diameter drogue chute which stabilizes and then decelerates the capsule to about 140 kt. equivalent airspeed.

At the time of drogue ejection, a cloud of chaff is also released to give search radars a solid fix.

At 10,000 ft., the drogue disconnects, deploys the main 63-ft. diameter ringsail parachute, and ejects a Sofar bomb. The bomb drops into the ocean and explodes at a preset depth for an accurate sonar fix on the impact point.

The main chute inflates in two stages to minimize opening shock. The first stage is a restrained opening which lasts about four seconds, and then the restraint line is cut and the chute opens fully. Final sink speed is about 30 fps.

McDonnell's first swing into space problems began in October, 1957, with the creation of a space group of 10 designers in engineering's advanced design section. They started with feasibility studies of Dyna-Soar types of vehicles, branched out into orbital and re-entry flight problems. By March, 1958, they had submitted the company's first entry in space-flight competitions: a design proposal on USAF's Dyna-Soar project.

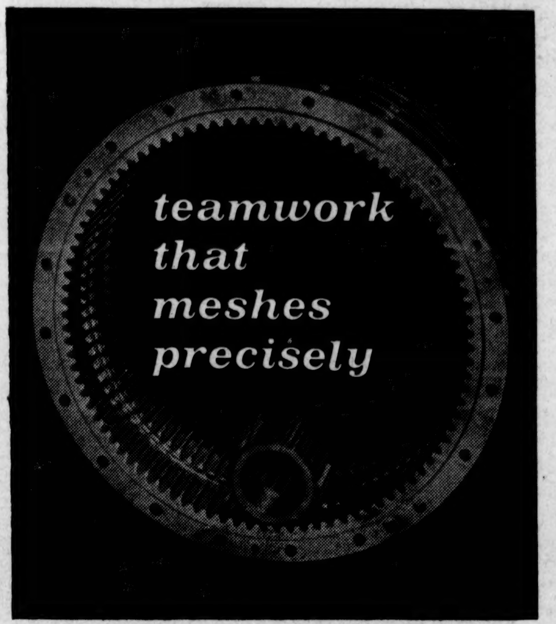
In October, 1958, NASA organized its Space Task Group at Langley Research Center to manage the manned space flight system which would become the Mercury project, and invited about 40 potential bidders to a Nov. 7 contractors' briefing on Mercury.

McDonnell submitted its Mercury proposal on Dec. 11, 1958, along with 11 other contractors. On Jan. 9, 1959, T. Keith Glennan, then NASA's head, called McDonnell to announce that the company had won the Mercury capsule contract, and that they could get started. It took a few weeks to organize the paper work; the contract was signed Feb. 6, 1959, between NASA and McDonnell covering ". . . development and construction of a spacecraft designed to withstand any known combination of acceleration, heat and aerodynamic loads that might occur during boost or re-entry, as well as land or water landing."

McDonnell's advanced design group became the core of the Mercury project and within two weeks had moved to new quarters close to the manufacturing area where the capsules would be built.

The group reached agreement rapidly with NASA on configuration of the capsule. The company's detailed proposal had suggested two alternate configurations: a finned body and a capsule-escape tower layout. The escape-tower configuration was the chosen form, and in its final design is very close to the original scheme of the proposal.

Some of the systems subcontractors had been lined up long before the contract award, and had participated in the program with their own funds to help arrive at the final proposal submitted by McDonnell. With this early experience under their belts, these companies swung into the project with minimum delays, and others were



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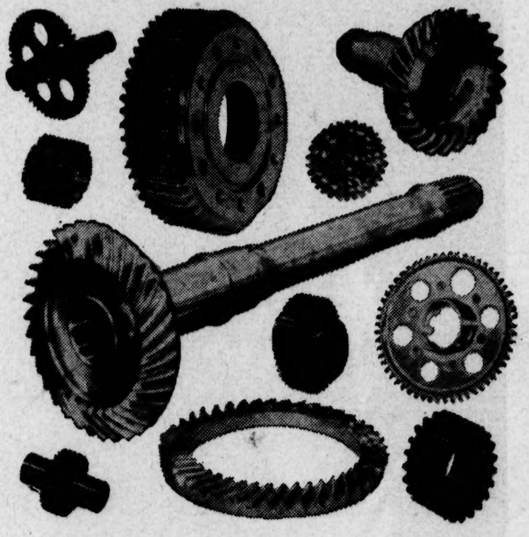
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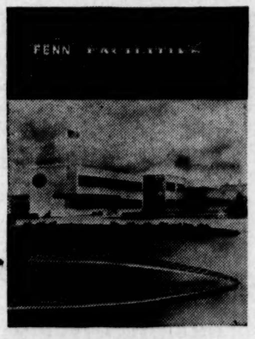

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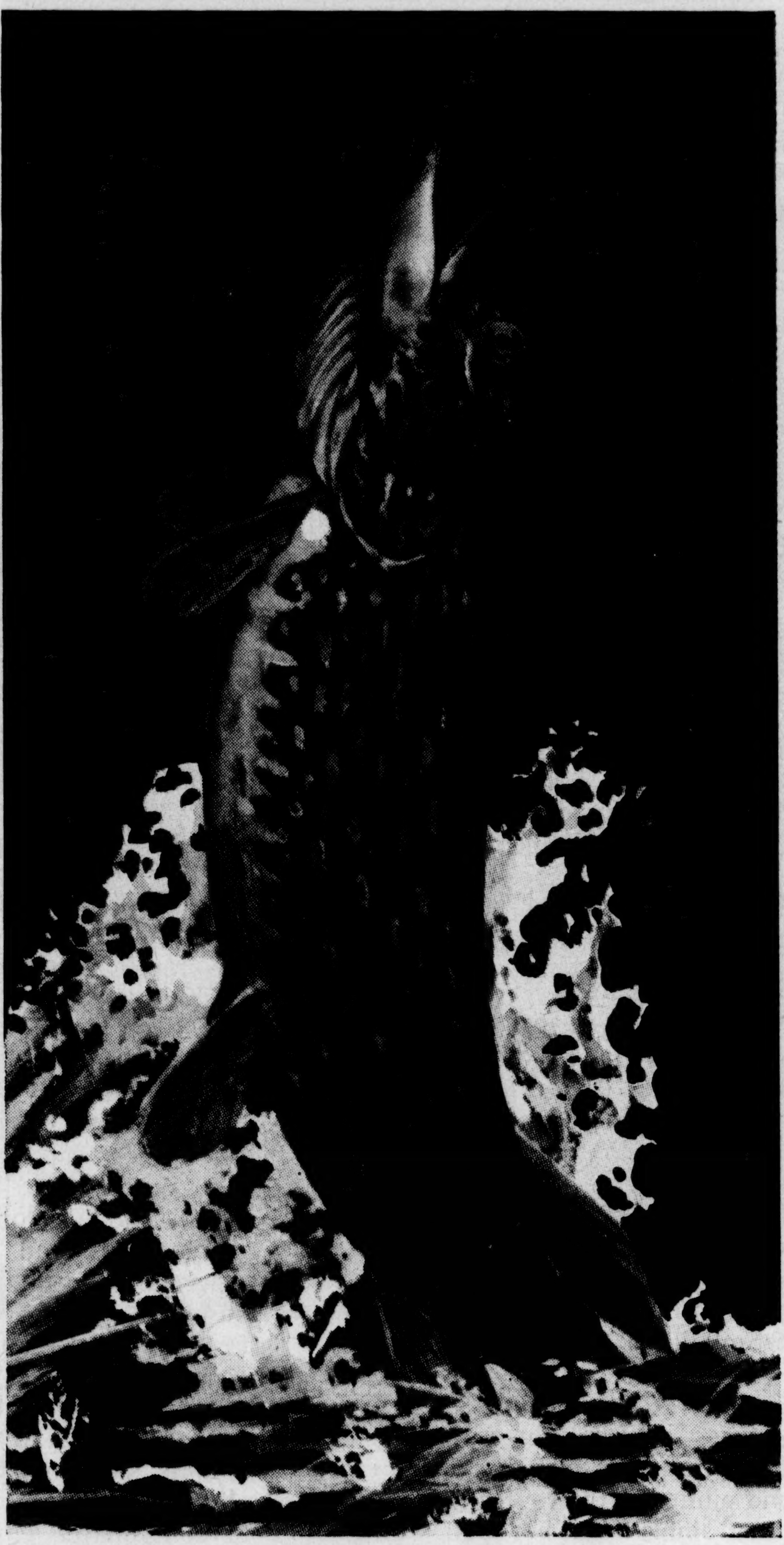

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brought in as rapidly as possible.

The Mercury project was authorized at a DX priority level, with overtime allowed and procurement simplified as two results of this high-priority rating.

McDonnell set up a classical vertical line organization to handle the project under manager E. M. Flesh; specialty groups, such as stress, aerodynamics, test and others—all horizontal organizations—were fed into the line at the proper places. Peak engineering strength on the project was close to 900; about 500 technicians were involved in the tricky manufacturing of the capsules.

Sixteen months to the day after Glennan's telephone call, McDonnell's first production capsule was boosted off the pad at NASA's Wallops Station, Va.

Shot Chronology

Two types of Mercury test vehicles were used in the two-phased test firing program. First series of shots used full-scale "boilerplate" models of the capsule to check out booster-spacecraft integration and the escape system. Second phase of the development firing program used complete Mercury capsules built to production standards.

This is the chronology of test firings:

- **Oct. 4, 1959:** Little Joe 1, fired at Wallops Station, Va., to check matching of booster and spacecraft capsule. Eight solid-propellant rockets producing 250,000 lb. of thrust drove the test vehicle.
- **Nov. 4, 1959:** Little Joe 2, also fired from Wallops Station, was an evaluation of the low-altitude abort conditions.
- **Dec. 4, 1959:** Little Joe 3, fired at Wallops Station to check high-altitude performance of the escape system. Rhesus monkey Sam was used as test subject.
- **Jan. 21, 1960:** Little Joe 4, fired at Wallops Station to evaluate the escape system under high airloads, using rhesus monkey Miss Sam as a test subject.
- **May 9, 1960:** Capsule 1, shot BA-1. McDonnell's first production capsule and its escape rocket system were fired in an off-the-pad abort test at Wallops Station. No booster was used; test was to evaluate the escape rocket system.
- **July 29, 1960:** Capsule 4, shot MA-1. This was the first Atlas-boosted flight, and was aimed at qualifying the capsule under maximum airloads and afterbody heating rate during re-entry conditions. The capsule contained no systems and no test subject. Shot was unsuccessful because of booster system malfunction.
- **Nov. 8, 1960:** Capsule 3, shot LJ-5. This was another in the Little Joe series from Wallops Station. Purpose of the shot was to check the production capsule in an abort simulating the most severe conditions during an Atlas launch. Capsule did not separate from the Little Joe booster and the shot was unsuccessful.
- **Nov. 21, 1960:** Capsule 2, shot MR-1. This was the first unmanned Redstone-boosted flight, but premature engine cutoff activated the emergency escape system when the booster was only about one inch off the pad. The booster settled back on the pad and was damaged slightly. The capsule was recovered for re-use.
- **Dec. 19, 1960:** Capsule 2, shot MR-1A. This shot was a repeat of the Nov. 21 attempt, but was completely successful. Capsule reached a peak altitude of 117 naut. mi., covered a horizontal distance of 204 naut. mi., and was recovered successfully.
- **Jan. 31, 1961:** Capsule 5, shot MR-2. This was a Mercury-Redstone shot which carried Ham, the 37-lb. chimpanzee. The capsule touched 135-naut. mi. altitude, covered 364 naut. mi. downrange, and was recovered. During the landing phase, the parachuting capsule was drifting as it struck the water. Impact of the angled blow slammed the suspended heat shield against a bundle of potted wires, which drove a bolt through the pressure bulkhead, causing the capsule to leak. Ham was rescued before the capsule had taken on too much water.
- **Feb. 21, 1961:** Capsule 6, shot MA-2. This Atlas-boosted capsule shot was to check maximum heating and its effect during the worst re-entry design conditions. Peak altitude was 93 naut. mi.; but re-entry angle was higher than planned and the heating was correspondingly worse than anticipated. Maximum speed was about 13,000 mph. Shot was successful.
- **Mar. 18, 1961:** Capsule 14, shot LJ-5A. This was a repeat shot of the unsuccessful Little Joe 5; it was fired at Wallops Station and was only marginally successful.
- **Apr. 25, 1961:** Capsule 8, shot MA-3. This was an Atlas-boosted shot attempting to orbit the capsule with a "mechanical astronaut" aboard. But 40 sec. after launching, the booster was destroyed by radio command given by the range safety officer. The capsule was recovered and will be fired again as shot MA-3A.
- **Apr. 28, 1961:** Capsule 14, shot LJ-5B. This was the third attempt to check the escape system under worst conditions, using a Little Joe booster fired from Wallops Station. Capsule reached 40,000 ft., and this time the shot was a complete success.
- **May 5, 1961:** Capsule 7, shot MR-3. This Redstone-boosted shot carried Astronaut Alan B. Shepard, Jr. (Cdr., USN) on a ballistic flight path reaching a peak altitude of 97 naut. mi. and a downrange distance of 254 naut. mi. Flight was successful.

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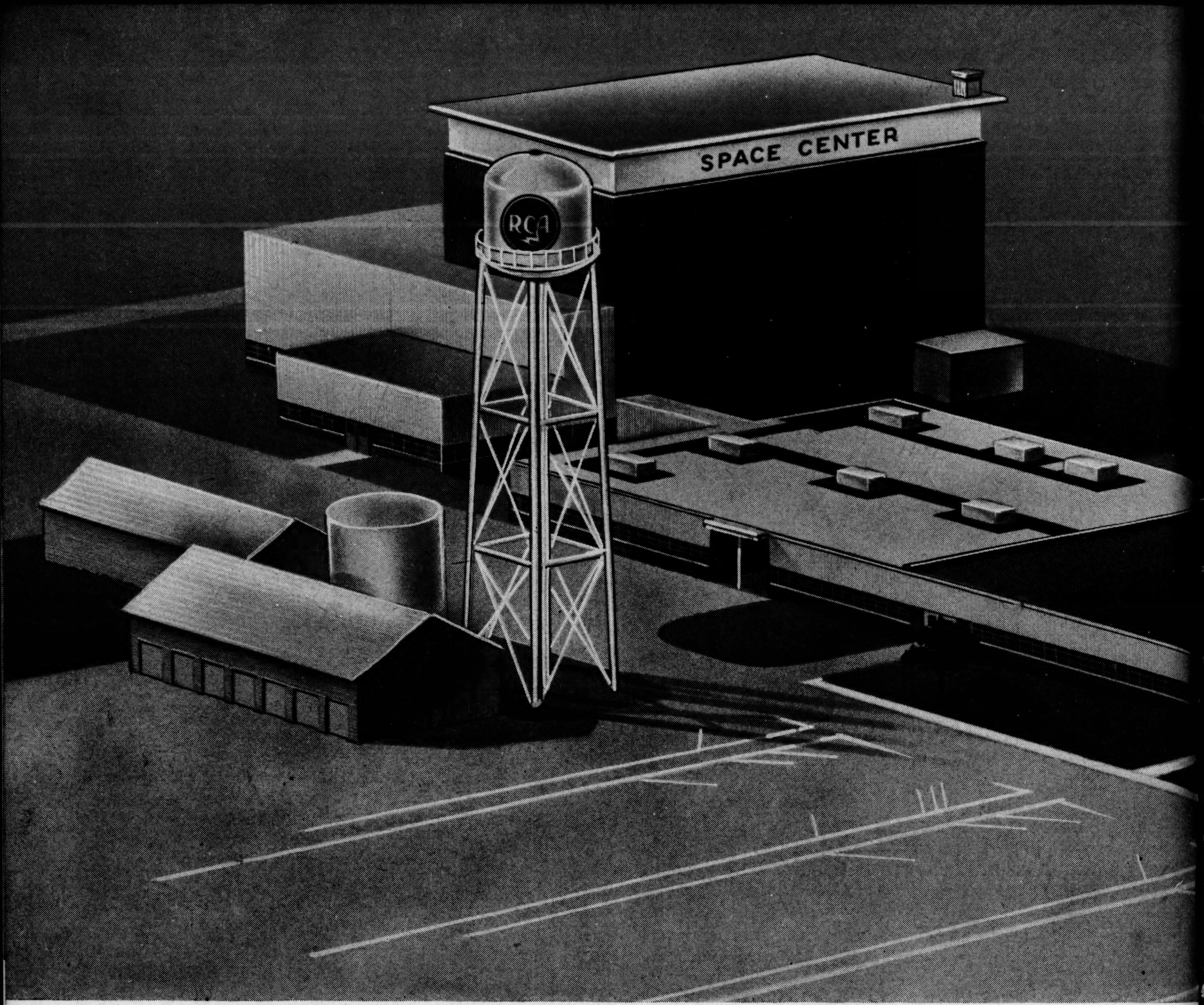

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Included in the new environmental equipment and facilities being built and installed at the RCA Space Center are the following advanced testing devices:

Vacuum-Thermal Chamber—measuring 28 feet in diameter and 25 feet high to accommodate the coming generations of space vehicles and satellites and meet all vacuum-thermal requirements.

Vibration System—provides 28,000 pounds peak force for sinusoidal, and 28,000-pound rms force for random motion testing.

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The entire RCA Space Center, which contributed to the success o projects such as SCORE, TIROS I, TIROS II and ECHO I, continues to be dedicated to the conception, development and production of earth satellites, space vehicles and ground support and information handling equipment. For additional information about RCA' engineering talents and proved capabilities, contact the Manager, Marketing, RCA Space Center, Box 800, Princeton, N. J. And, for a complete description of the new environmental facilities, write fo your copy of the brochure "RCA Space Environment Center."

If you are interested in participating in the challenging opportunities that exist at the RCA Space Center, contact the Employment Manager, Astro-Electronics Division, Defense Electronic Products, Princeton, N. J. All qualified applicants are considered regardless of race, creed, color or national origin.

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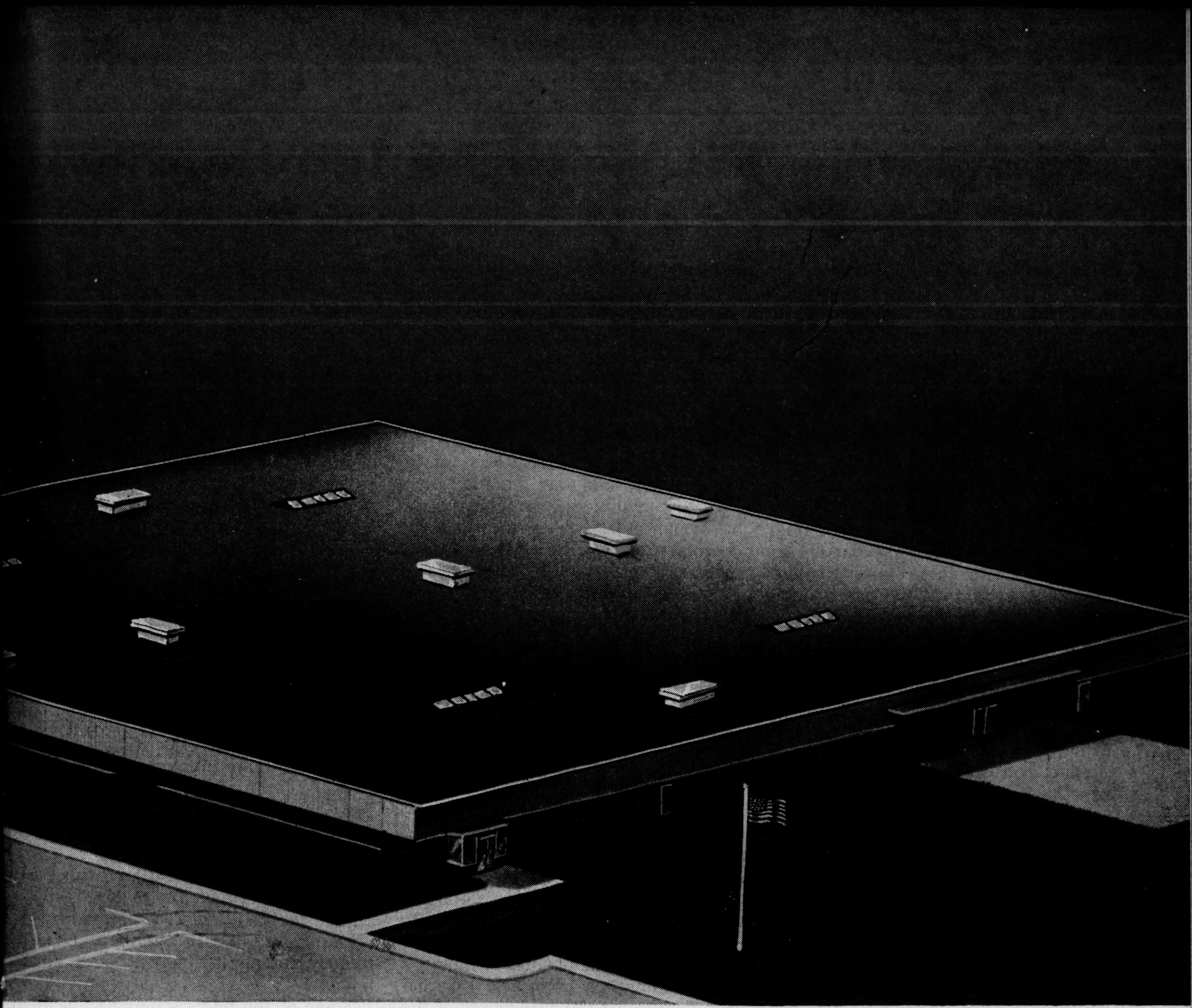
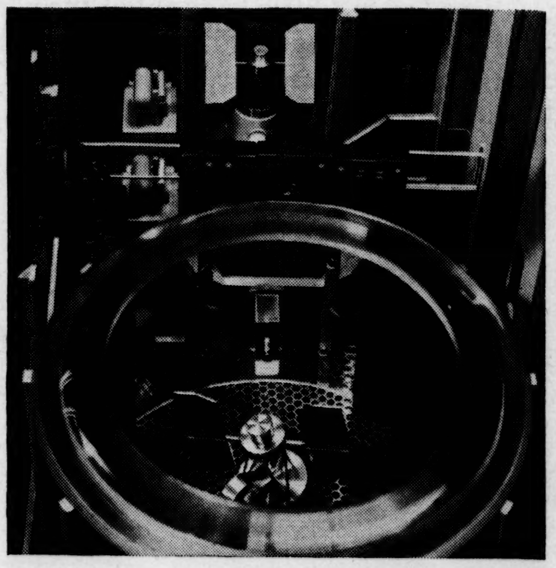
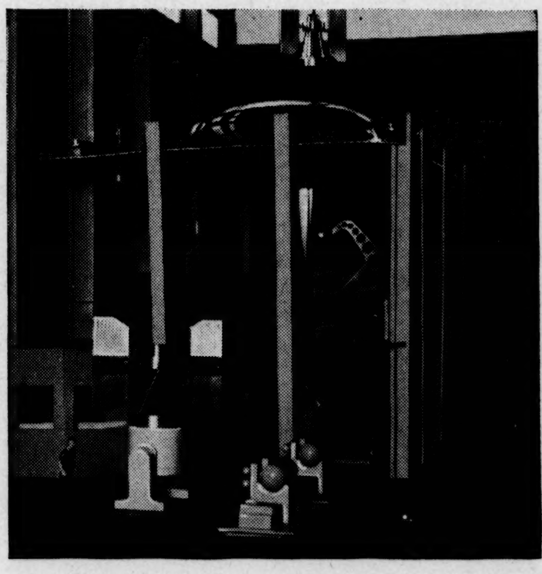
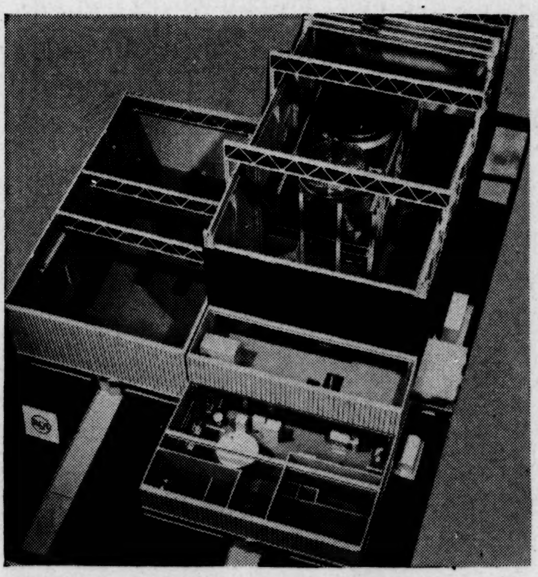




New advanced Vacuum-Thermal facility shown in model has pumping system that can reduce pressure to 5×10^{-6} mm Hg within 24 hours with a 3500-pound payload in the enclosure.



New Vibration System will include 28,000-pound exciter driven by an amplifier capable of delivering 140 KW over a frequency range of 25 to 10,000 cps.



All existing environmental equipment will be housed here and a new high-bay assembly area provides facilities for assembly of an increased number of space systems.

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All-Weather F-105s Phase Into Europe

By Cecil Brownlow

Wiesbaden—Republic Mach 2-plus F-105 fighter bombers are beginning to phase into the United States Air Force in Europe, providing this front-line force with an integrated all-weather tactical arm for the first time, a feature sorely needed above frequently-overcast West Germany and airspace to the east.

The first F-105 arrived last week at Bitburg Air Base, which is near Luxembourg and approximately 300 air miles from the East German border, after a transatlantic ferry "high flight" from Brookley AFB, Mobile, Ala. The F-105s will bring with them their complex avionic stores that will put added strain upon USAFE's field maintenance operations.

Aircraft for the Air Force's first wing of the all-weather D version of the F-105 series will continue to arrive over the next several weeks as the unit builds to full strength.

Officials at USAFE headquarters here hope that sufficient aircraft and crews will be on hand for the wing—the 36th, transitioning from North American F-100s—to fly in force to Wheelus Air Base, Libya, for gunnery and weapons delivery training sometime in July.

Planning for integration of the F-105 and its conventional and atomic stores into the 36th Wing and subsequent USAFE units scheduled to receive the aircraft has been under way here for well over two years in an effort to have the necessary facilities, spares and technical capability on hand in time for the initial F-105 deliveries from Brookley.

Despite the complexities centered around the heart of the system, the necessarily-complex R. 14 all-weather navigation and fire control system developed by North American Aviation's Autonetics Division, USAFE hopes to maintain the aircraft in the field essentially as a "blue suit routine," according to one official here who has been connected with the program for the past two years.

Ground Facilities

Necessary facilities have been, or are being, built, and the ground crews selected carefully in order to avoid the maintenance hazards surrounding the initial appearance of the relatively less-sophisticated F-100 to the theater in 1955. At that time almost complete reliance had to be placed for a while upon the major industry contractors involved since the needed technologies surpassed the know-how of most of the available Air Force maintenance personnel.

"We're in much better shape now [for acceptance of the F-105] so far as airways, facilities and training [AW Apr. 17, p. 88] go than we were in 1955 when the F-100s began to come in," according to one USAFE planning officer. He added:

"I'm not really concerned about it myself. I think we're going to be able to manage very well . . . [although] it has taken a lot of man-hours, including a special committee from here that has been monitoring the final phases of the operation for the past eight months . . . to be sure we're as ready as we can be."

Maj. Gen. Benjamin O. Davis, Jr., USAFE deputy chief of staff for operations and a prime mover behind the F-105 preparations in Europe, praised the all-weather potential of the aircraft as "something fighter pilots have been looking for since World War II. He agreed, however, that the ground and aircrew training chores plus the maintenance hurdles that lie ahead are "tremendous."

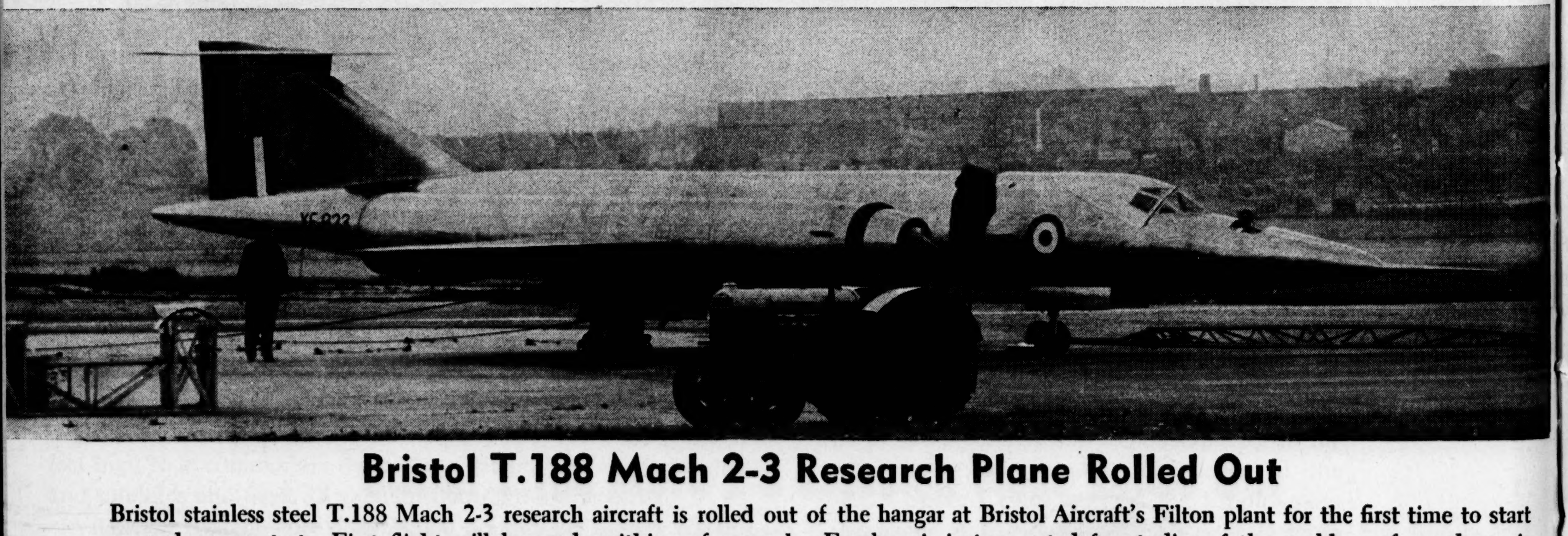
USAFE considers what Gen. Davis terms the "vast increase" in the operational capability represented by the F-105—the ability to fly in almost any weather, find the target and return to home base—important enough so that it has been "going all over Europe telling people, particularly the Army, what we can do when we get this aircraft in numbers." So far as integration of weapon system and crews into the command is concerned, Gen. Davis adds:

"The course at Nellis [AFB, N. M., for the F-105 pilot] should make him almost combat-ready. The time he spends there is a compromise. The more time we give to Nellis, the more time we lose over here. It's going to take quite a bit more training from us.

". . . I think we're going to be in pretty good shape a year from now for more than one unit . . .if not before."

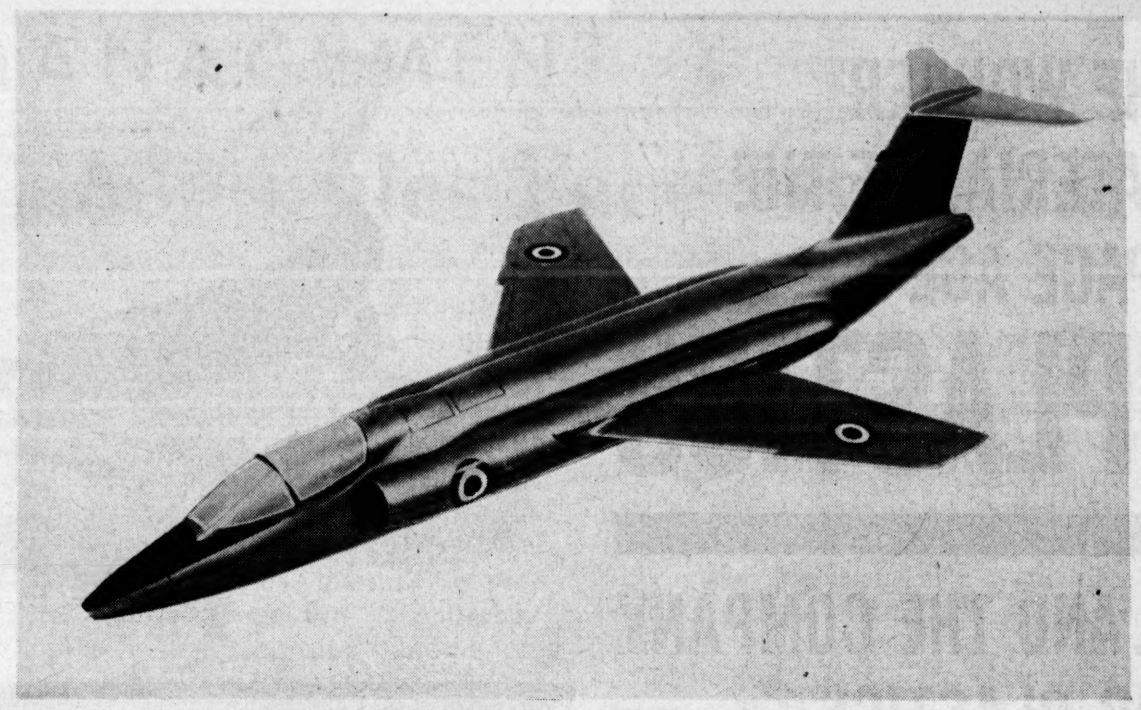
Another USAFE officer, in discussing the training problems involved, described the F-105 and its subsystems as "complex, yes, but to describe it as 'extremely complicated' might be a misnomer."

Some of the pilots training at Nellis who are being confronted with an integrated radar flight system for the first time "were a little leery about the whole thing," he conceded. "But now they think it's a real fine-handling airplane. . . . They tell us they can hack it."



Bristol T.188 Mach 2-3 Research Plane Rolled Out

Bristol stainless steel T.188 Mach 2-3 research aircraft is rolled out of the hangar at Bristol Aircraft's Filton plant for the first time to start ground run-up tests. First flight will be made within a few weeks. Fuselage is instrumented for studies of the problem of aerodynamic heating at high speeds. Powerplants are two de Havilland Gyron Jr. D.G.J. 10 jets, producing 10,000 lb. thrust each with afterburning.



Fiat G. 95/3 VTOL Fighter

General configuration of Fiat's design study for a VTOL follow-on to the G. 91 lightweight strike fighter is shown in the company's conception above. Designated the G. 95/3, the proposal is one of three drafted by Fiat for the current North Atlantic Treaty Organization S/VTOL close-support fighter competition. The other two studies, designated G. 95/1 and G. 95/2, are both STOL vehicles. G. 95/3 would attain vertical lift from four lightweight auxiliary engines housed in the fuselage, two immediately behind the cockpit and two forward of the tail section as indicated by two main powerplants.

Slightly more than half of the F-105 aircrews for the revised 36th Wing were sent from Bitburg to Nellis for combat aircrew training—"those that still have enough time remaining in Europe to make it worthwhile." The remainder have been selected from other Air Force units to fill out the quota.

All, however, must be "Century-series qualified" and as a general rule must have flown a minimum of 100 hr. in these types of aircraft within the past year.

The Nellis course itself requires approximately 61 calendar days to complete, including about 45 hr. per pilot in the F-105D plus additional flights for radar navigational training aboard a North American T-39 Sabreliner jet utility aircraft.

The first class for the 36th Wing pilots began on Mar. 6. The program calls for 35 to be at Nellis at any one given time—17 in one class, 18 in another—until training is completed.

Ground crews are being trained both within the U. S.—by the Air Force and by Republic Aviation Corp. technicians—and in Europe, the latter relying primarily upon a mobile USAF Training Command unit incorporating simulator instruction, theory, etc.

The course for ground crewmen varies in length from one to 18 weeks depending upon the requirements for the 12 specialties involved. As an example, crew chiefs representing the largest group involved require approximately seven weeks of schooling, electronics technicians 10 weeks and beyond.

Over-all, the specialists needed by the 36th Wing in its transition from F-100s to the F-105 will jump from roughly 800 to over 1,000, with almost all the additional men being routed into one phase or another of the R. 14 self-contained navigation system. "The F-100," one spokesman said, "has a marginal all-weather capability, but only if you can put him over the target and talk him down from the ground. This will be something new for us."

As a backup, about 30 civilian technicians from Republic, North American Aviation and Pratt & Whitney Aircraft Division of United Aircraft Corp., which manufactures the 26,500-lb.-thrust J75 powerplant for the F-105D, will be on hand at Bitburg on a continuing basis to aid in the initial integration and day-by-day maintenance.

As an additional backup, Republic is proposing the establishment of an airframe and avionics maintenance and overhaul facility at the Amsterdam site of its European affiliate, Royal Netherlands Aircraft Fokker. For support, European electronic firms also probably would be brought into the project, including The Netherlands' giant Philips' Gloeilampenfabrieken.

A Republic spokesman said that, although the plan is still under consideration by the Air Force, "we believe it's needed so that we don't run the risk of having to send the aircraft back home for major maintenance and repair."

For the moment, USAF hopes to conduct maintenance and periodic inspections at Bitburg with its "blue suit" technicians and civilian representatives stationed there. "If something special comes up—say crash damage—an Air Materiel Command mobile crew can be over here in a day to help us out," one Air Force official said.

Maintenance Requirements

Maintenance capability and requirements will be re-evaluated after a year of operation in the field to see what more, or less, is needed to assure adequate support, although some changes in the system may be made in the interim.

In conjunction with the Tactical Air Command, Republic and other contractors, USAFE began constructing new facilities geared for the F-105 at Bitburg more than one year ago. Many of them, one officer says, "were needed for the F-100, but we couldn't justify them until we got a new piece of equipment."

Some have been completed, others will not be ready for six or eight months, but, "in every case we have an interim capability," he said.

Increased size of the F-105—a fuselage length of slightly more than 64 ft. as compared with 47 ft. for the F-100—has made it necessary to pour new concrete to provide additional ramp space and, in some instances, the enlargement of the earthen alert and dispersal standby revetments.

New facilities needed include engine test stands to accommodate the J75, buildings and large test benches for F-105 armament and advanced electronics systems and mobile maintenance shelters, which are being converted from units originally designed for the F-102.

The Air Force also has attempted to see that sufficient spares are in place at Bitburg and F-105 dispersal sites from the beginning in order to minimize the risk of aircraft being grounded for lack of parts. Spares logistics responsibility remains solely in the hands of USAF and will be handled in conjunction with Air Materiel Command.

On the "high flight" ferry junkets, the aircraft will be flown in groups of four from Brookley AFB. The plan calls for nonstop hops to Europe with in-flight refueling from Tactical Air Command Boeing KB-50 piston-engine tankers. However, the Mobile Air Materiel Area, which has management responsibility for the F-105, has installed en route support kits at points on both the southern and northern routes to Europe in case weather, mechanical malfunctions or missed refueling rendezvous make interim stops necessary.

Aircraft are flown from Republic's Farmingdale, N. Y., facility to Brookley where they are put through their acceptance tests and prepared for the ferry flights by the installation of additional fuel tanks in Mobile for a maximum of 20 days before being deployed to Europe, but Brookley officials hope to maintain an average of approximately 15 days.

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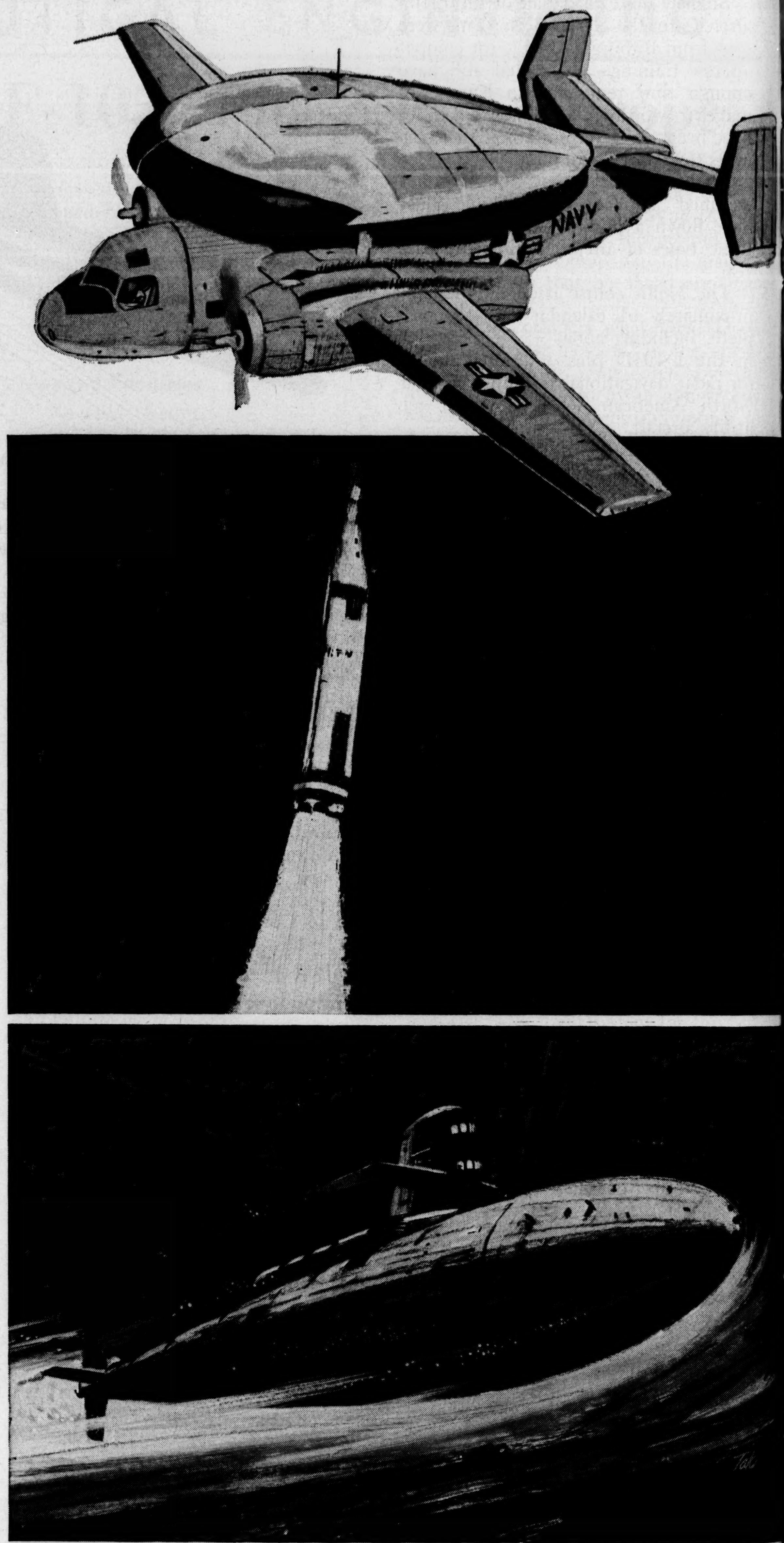

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Consider the many benefits of plastics in your aircraft, marine, and space projects before you seal the design. Remember, the wonder material of the space age is plastics... and the company for plastics is Zenith.

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Missile Base Labor Rules Face Overhaul

By George C. Wilson

Washington—Future pattern of labor-management relations at defense installations is at stake in discussions underway in the White House, Congress and international labor unions.

Officials at all three quarters have proposed solutions to the labor problems spotlighted recently by Sen. John L. McClellan's Permanent Investigations Subcommittee in its probe of strikes and slowdowns at missile bases.

The question now is which of the rival proposals, or combination of them, will prevail.

Sen. McClellan (D.-Ark.) on the one hand is demanding a no-strike law while labor on the other contends it can clean its own house with tools already available. Between these opposing forces is the Kennedy Administration, with promises to use presidential powers to prevent work stoppages at missile test centers and operational sites.

Off to the side of these contenders is a Labor Department study group analyzing the Davis-Bacon Act's application to missile base construction and installation work. The 1931 act—which authorizes the government to set wage minimums on a federal project—has been blamed for much of the labor trouble detailed in the McClellan hearings.

First Ground Rules

The outcome of these related issues—the general peace formula and Davis-Bacon recommendations—will be the first set of labor-management ground rules tailored to missile work.

Besides preventing strikes and walkoffs, such a set of ground rules hopefully will make it easier for contractors to use factory technicians on many of the missile jobs that construction unions now insist on doing; save the government the vast amounts of overtime disclosed by the McClellan committee, and provide more guidance and authority both for government contracting officers and the contractors themselves for breaking bottlenecks on missile projects.

The missile-age ground rules will be part of the legacy of the Permanent Investigations Subcommittee's hearings, held Apr. 25 through 28 and on May 2, 3, 4 and 5. Chairman McClellan termed disclosures in those hearings "equally, if not more, shocking than anything that has been revealed in the nearly five years of labor-management relations investigations conducted by two senatorial committees."

Subcommittee members during the hearing criticized the Air Force, contractors and unions for permitting delay and waste in the missile program.

USAF Maj. Gen. William Thurman, assistant for production programing in the office of the deputy chief of staff, materiel, testified that many of the problems stemmed from the "concurrency" approach—designing and building production facilities for missiles all at once.

"Concurrency has contributed to a number of novel and complicated problems, including the labor problems at missile sites," he said. "Inevitable changes in design, delays in construction, delays in development and delivery of equipment" were major causes for the conditions uncovered by the subcommittee, he said. Other Air Force officers testified they authorized overtime to keep the program on schedule.

Labor Views

Contractors blamed both the lack of Federal guidance on missile construction and the unions for many of their difficulties. They cited the failure of the Labor Department to issue criteria for determining application of the Davis-Bacon Act. Jude M. Joseph, president of Modern Electrical Contracting Co. of Jacksonville, Fla., in an example of labor trouble, said he laid off two electricians for not producing at the Air Force Missile Test Center at Cape Canaveral, Fla., but had to hire them back before the local union would send back the rest of the electricians who had walked off the job in protest.

International heads of the labor unions were scheduled to give their side of the story on May 10, but the hearings were postponed by Sen. McClellan so they would not interfere with efforts of Secretary of Labor Arthur J. Goldberg and the unions to agree on a no-strike pledge at defense installations.

C. J. Haggerty, president of the AFL-CIO Building Trades Department, filed a statement with the subcommittee declaring: "The preponderance of evidence from all sources shows that the delays in the completion of the missile base construction program are primarily due to non-labor factors, such as the inordinate number of change orders resulting from the concurrency policy." He said jurisdictional disputes were "greatly exaggerated" by subcommittee witnesses. Haggerty said only about 2% of missile work falls in the area of jurisdictional controversy.

Testimony at the McClellan hearings disclosed that:

- **U. S. intercontinental** ballistic missile effort lost over 400 years of man-days because of labor disputes. The Air Force testified that 162,872 man-days were lost at ICBM bases between the start of the program in 1956 and Mar. 31, 1961, because of work stoppages. This is the equivalent of a work force of 1,000 men standing idle for more than five months.

Of the 162,872 man-days lost in 327 strikes, 112,322 were lost at these three test sites: Edwards AFB, 2,076 man-days; Cape Canaveral, 87,374 man-days; and Vandenberg AFB, 22,863 man-days.

Of the operational ICBM sites, these three lost the most man-days: Warren AFB, 23,664 man-days; Forbes AFB, 6,935 man-days; Offutt AFB, 6,642 man-days. All told, the 19 operational sites accounted for 50,550 man-days lost, in 195 strikes.

- **Unions demanded and got** so much overtime and other special pay that some electricians at Cape Canaveral and Vandenberg made more than $700 a week.

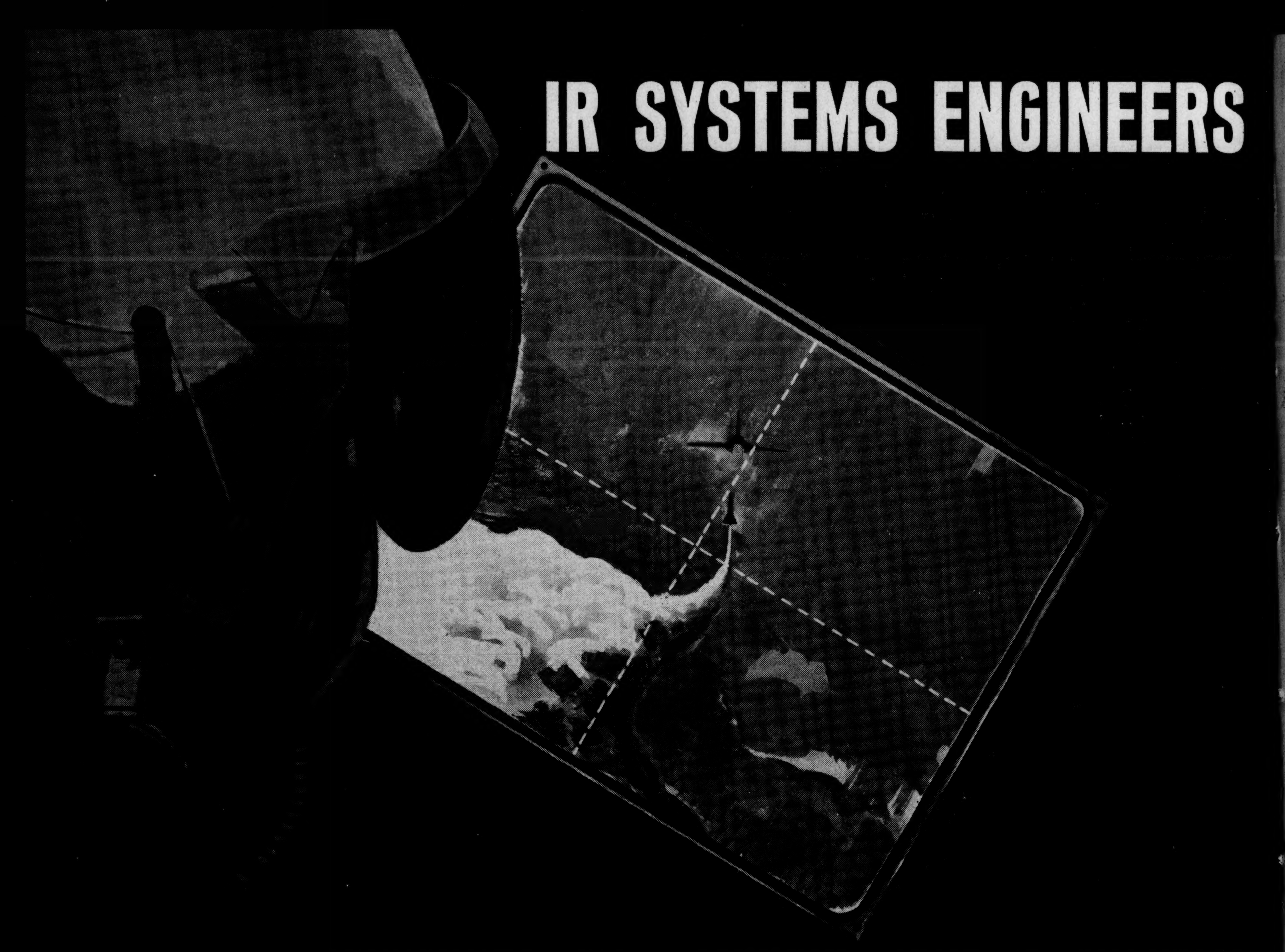
Robert E. Dunne, assistant subcommittee counsel, included these examples of earnings at missile bases in his testimony: Joseph H. Baker, journeyman electrician, from Aug. 19, 1958, to Nov. 11, 1958, worked at Cape Canaveral for the Almond Electric Co. of Dallas, Tex., and earned no less than $426 a week and as high as $772 a week; plumbers and pipefitters working for the Bechtel Corp. at Vandenberg made between $402 and $733 a week, common laborers up to $287 a week, and two elevator operators at Vandenberg made up to $360 a week.

The unions obtained agreements with contractors so that work shifts provided a maximum of overtime as well as extra pay for working 40 ft. above the ground on a missile.

McClellan, in summing up the hearings to date, said many of the work stoppages "were deliberately called to create the need for overtime work. The testimony has shown that both the unions and men knew scheduled target dates had to be met and that postponing the work would necessitate lucrative overtime if the jobs were to be finished on time."

Other testimony disclosed instances of Air Force contracting officers authorizing overtime that the contractors did not think was necessary; of workers walking off the job when they could

IR SYSTEMS ENGINEERS



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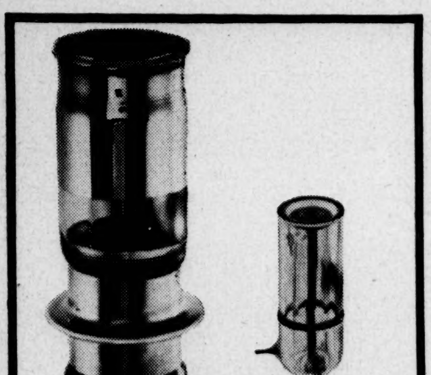

electrical characteristics at minus 196°C

Parameter	Detectivity and Impedance Ranges Available				
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not get the overtime they demanded, and of suspected tampering with missiles so work would be prolonged.

- **Jurisdictional disputes** between unions reached the point where the construction workers at the site insisted on redoing work already performed by workers at the factory.

The "blessed" manifolds were a celebrated example of these jurisdictional disputes. Ewell H. Hodge, a former contracting officer at Vandenberg who said he resigned from the Air Force because of the frustrations of his job, said the pipefitters insisted on reassembling missile manifolds which had been assembled in the factory.

However, after pleas from the contractor and Hodges that the reassembling in the field might throw off the delicate adjustments made in the factory, the pipefitters union agreed to "bless" the manifolds. This consisted of the field pipefitters sitting around for the number of hours they figured it would have taken them to assemble the manifolds. The pipefitters put a "blessed" mark on the manifold and then sat around until it was time to "bless" the next manifold.

Eventually, the pipefitters forced the contractor to let them assemble the manifolds in the field, Hodge said. In answer to why the pipefitters would not accept the factory-assembled manifolds, Hodge said: "The only thing that I hear expressed was the fact that it is contrary to their working agreement with the contractors association."

Sen. Carl T. Curtis (R.-Neb.) of the subcommittee criticized both the government and the contractor for the manifold procedure: "I think the government has a responsibility and I think also we need management in this country with a little more spine."

Sen. McClellan termed the blessing process one of "the most scandalous kind of jurisdictional make-work projects."

The Davis-Bacon Act authorizes the Secretary of Labor to stipulate the minimum wages for "construction, alteration and/or repair, including painting and decorating, of public buildings or public works of the U.S. . . ." The Secretary is directed to base the minimum wages on those prevailing in the area.

When the Air Force includes the Davis-Bacon clause in a contract, the contractor often finds construction unions claiming this gives them the right to do all the work on the project, even though the contractor wants some of the work done in the factory.

The Labor Department to date has not furnished criteria for determining just what constitutes construction at missile bases. This lack of guidance, according to several witnesses, aggravated jurisdictional fights among the unions which were involved.

Procurement Search

Washington—USAF's new Procurement Policy Development Branch has asked Rand Corp., Aerospace Industries Assn., National Security Industrial Assn., USAF Institute of Technology, the Industrial College of the Armed Forces and other organizations to help it find breakthroughs in contracting methods. It is asking what procurement methods should be 5 or 10 years from now and seeking to modernize procurement regardless of changes that might have to be made in concepts, statutory authority, etc. It also is soliciting private comments. Address is AFMPP-PR-4, Hq. USAF, Washington 25, D. C.

Douglas D. Dorman, vice president for industrial relations of the Martin Co., told the subcommittee "the building trades unions have attempted to claim jurisdiction over many elements of these weapon systems on the basis that the installation and assembly of the system at the site constitutes construction work under the [Davis-Bacon] Act . . . The Davis-Bacon Act should apply only to the permanent building structures and not to the missile or its related equipment."

Comparing a missile base with a house, Dorman said Davis-Bacon should apply to the house and lot—not to all the furniture in it. "The definition of a weapon system as a public work," he said, "is a perversion of the [Davis-Bacon] Act which was never designed to cover the situation we have today. Such an amendment to the act should define a public work as a permanent structural improvement of a piece of real estate owned and operated by the government of the U. S. such as a bridge, dam or fortress, but not including removable equipment such as ordnance, machinery, ground control, ground support or communicating systems."

Labor Secretary Goldberg on Apr. 25 named a Missile Site Public Contracts Advisory Committee to recommend criteria for applying the Davis-Bacon Act at missile installations. Dr. Thomas W. Holland, professor of economics at George Washington University, was appointed chairman of the three-man committee. Other members are Lloyd Bailer and Peter Seitz, New York arbitrators.

Dr. Holland told Aviation Week that the committee is studying material on hand before conducting public hearings on the Davis-Bacon Act. The hearings are expected to be conducted in June. Committee recommendations will be drafted after the hearings. Dr. Holland said the committee hoped to narrow the "gray area" between what is generally accepted as construction at missile sites and what is generally accepted as non-construction.

Sen. McClellan said on May 11 that despite executive action to stop strikes at missile bases, "I am fully convinced that the Congress needs also to meet its responsibility and pass legislation that will outlaw strikes and concerted work stoppages on government contracts, and particularly so in areas of national defense."

The shape of the no-strike legislation has not been determined. McClellan said there should be some kind of a panel established to settle labor-management differences.

"In this country we do not tolerate a man pointing a gun at another's head to collect a debt," Sen. McClellan said. "We provide a tribunal for wronged citizens to seek redress of their grievances. I do not know why our government cannot provide some kind of tribunal . . . that could resolve disputes arising between management and labor or between government and management or between government or labor . . . where work stoppages" would hurt the defense effort.

Jerome S. Adlerman, general counsel of the McClellan subcommittee, told Aviation Week he was not sure yet whether the no-strike law would be an entirely new one or whether it could be in the form of an amendment to existing labor legislation. This is under study, he said.

Sen. McClellan's no-strike legislation might be an amendment to the Labor Management Relations Act of 1947 (Taft-Hartley), which provides machinery for settling disputes.

Dorman, of the Martin Co., suggested that Congress amend the Taft-Hartley Act to empower the U. S. to sue unions which violated their contracts.

Section 301 of the act empowers employers to sue unions in District Courts for contract violations. Dorman said greater use of this section by missile contractors would solve many of the labor problems reported by subcommittee investigators. However, he recommended empowering the U. S. to sue if the employer did not do so within 15 days after work stopped.

Labor legislation calling for much more than a tune-up or a few new parts for the machinery already within the Taft-Hartley Act will have tough going in this Congress—especially with President Kennedy offering executive action as an alternative to a no-strike law.

President Kennedy, who received strong labor support during his political campaign, almost certainly will oppose any drastic no-strike legislation. Also, many members of Congress feel there are adequate labor laws on the books to prevent strikes at missile centers.

USAF-STL Link Criticized by House Unit

By Katherine Johnsen

Washington—The House Government Operations Committee is pressuring Air Force to phase out Space Technology Laboratories, Inc., the fully-owned subsidiary of Thompson Ramo Wooldridge, Inc., as technical manager of ballistic missile and space programs as rapidly as possible.

Air Force established Aerospace Corp. —a non-profit organization—to take over STL's manager role about a year ago, chiefly because of opposition from the committee to STL's conflicting roles as a private, profit-making corporation and an Air Force manager with privileged access to the files of missile and space contractors and a measure of indirect control over their operations.

When Aerospace was established, Air Force continued STL as technical manager of its three ballistic missile programs—Atlas, Titan, and Minuteman—to avoid disruption. It also left with STL a fuzzily-defined role of related research and development and systems engineering. Some restrictions on STL's production of hardware were removed when Aerospace was formed.

The committee now has restated its objections to STL's conflict-of-interest position, which it feels is now even more clearly defined, and—in a report drawn by its military subcommittee headed by Rep. Chet Holifield (D.-Calif.),—has objected to the overlapping and confused activities of STL and Aerospace.

To illustrate the "rather bizarre criss-crossings of management control," the committee pointed to the Advent communications satellite project. Army has established the U.S. Army Advent Agency for general management and STL is its technical adviser. In this role, STL oversees the work of Aerospace, which is technical manager for Air Force aspects of the Advent program. On wholly Air Force programs, Aerospace oversees STL.

The committee observed that between Air Force Systems Command offices and the industrial contractors, "there are now two technical organizations with varying degrees of responsibility for, and proximity to, the actual weapon building process. This refined and complicated division of labor, and the seemingly top-heavy management structure . . . is a consequence of the Air Force policy of coexistence for the two technical contract organizations. Aerospace comes in, but STL does not go out. . .

"Considering the fact that STL now has become an industrial organization seeking customers on a competitive basis like other industrial concerns . . . the Air Force should close out, as rapidly as possible, contract functions with STL which afford privileged access to industry data and technical decision-making responsibilities affecting the industrial careers of the associate contractors."

When bans on STL's production of hardware were removed, with the formation of Aerospace, "a crucial turning point in STL's corporate career," it speeded plans for the construction of a new STL industrial complex, the committee said.

"On a 110-acre site in Redondo Beach, Calif., the company [STL] is building a Space Research and Engineering Center, which it describes as 'the largest installation of its kind.' Scheduled for completion in March, 1962, the company advertises that 'this ultramodern complex will provide facilities for 5,000 employes, including 2,000 scientists and engineers.' The first phase of construction comprises six research-engineering office buildings, an engineering office building, a library-auditorium, a service building, and the headquarters building." STL is also setting up district and field offices at major locations of government customers, including Washington, Dayton, Boston, and Huntsville, Ala.

The committee also noted that STL has formed a new "Products Division" to market scientific and technical devices investigated in the course of research in space and ballistic missile technology. It noted: "The first two items, to be placed on the market in April 1961, are described by STL as 'the world's fastest electronic camera and a highly portable, unusually stable, independent atomic frequency standard.'"

Despite the transfer of USAF technical direction functions to Aerospace in mid-1960, STL total "sales" of $84 million for the calendar year exceeded the 1959 level. At the end of the year, the committee said, STL "had a healthy backlog and contracts in force numbering approximately 60." Its customers included National Aeronautics and Space Administration, Air Force, Army, Navy, and Atomic Energy Commission.

The "bright new feather in STL's cap," the committee observed, was an $18.4-million NASA contract for the Orbiting Geophysical Observatory. STL's proposal, calling for delivery of three flight spacecraft within three years, was chosen from eight submitted.

Air Force outlays to STL in Fiscal 1960 for technical direction functions totaled $78.7 million. For Fiscal 1961, this outlay will be increased to $84.3 million and divided $48.7 million for STL and $35.6 million for Aerospace.

In Fiscal 1960, STL's USAF total was allocated $54.4 million for ballistic missiles and $24.3 million for other programs. In 1961, the STL total is allocated $41.5 million for ballistic missiles, $7.2 million, other programs.

Aerospace's Fiscal 1961 total is divided $26.5 million for ballistic missiles and $9.1 million for other programs.

These are the $7.2 million worth of non-missile programs STL has underway in the current fiscal year: continuation of work on the NASA Able III and IV programs, involving primarily tracking the Able IV Venus probe and analysis of data obtained, $300,000; continuation of work on the NASA Able V launch, $5.3 million; continuation of work on the Tiros, Transit and Courier programs, including fabrication of the guidance system and guidance into orbit of additional Transit launches, $1.6 million.

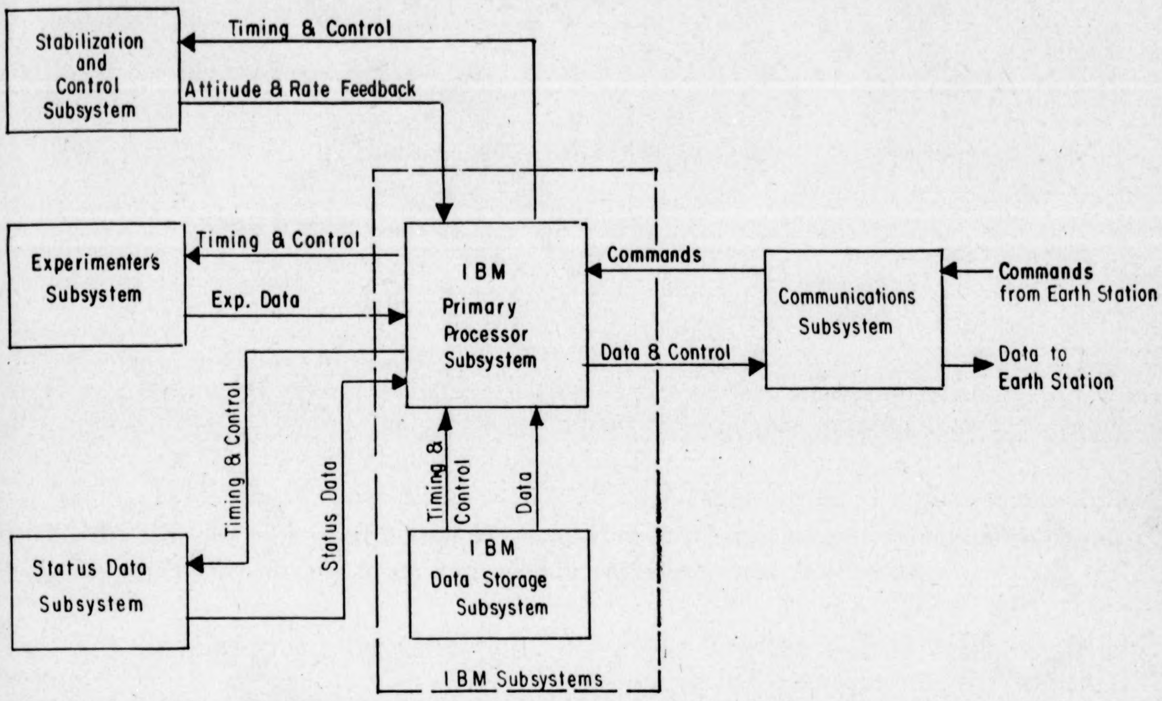
Aerospace's non-missile programs for Fiscal 1961 are: systems engineering and technical direction of Navy Transit IIIB and IVA launches, $700,000; work on Project Mercury, transferred from STL, $1.7 million; integrating payload with launching vehicles and orbiting of communications satellite (Advent), $1 million; initial design criteria, analysis and advance planning on satellite inspection program (Saint), $850,000; general systems engineering and technical direction of Air Force responsibilities in testing of Army Nike Zeus anti-missile system, $500,000; systems analysis, general design criteria, and evaluation of technical proposals for orbital interceptor (Bambi), $920,000; systems engineering and technical direction for launching vehicle and mating of the Dyna-Soar payload, $1.1 million; launching vehicles and activities required to place two instrumented payloads in orbit in connection with outer space test (Vela Hotel project), $258,000; and systems engineering and technical direction in the Samos E-6 reconnaissance system, $1.1 million.

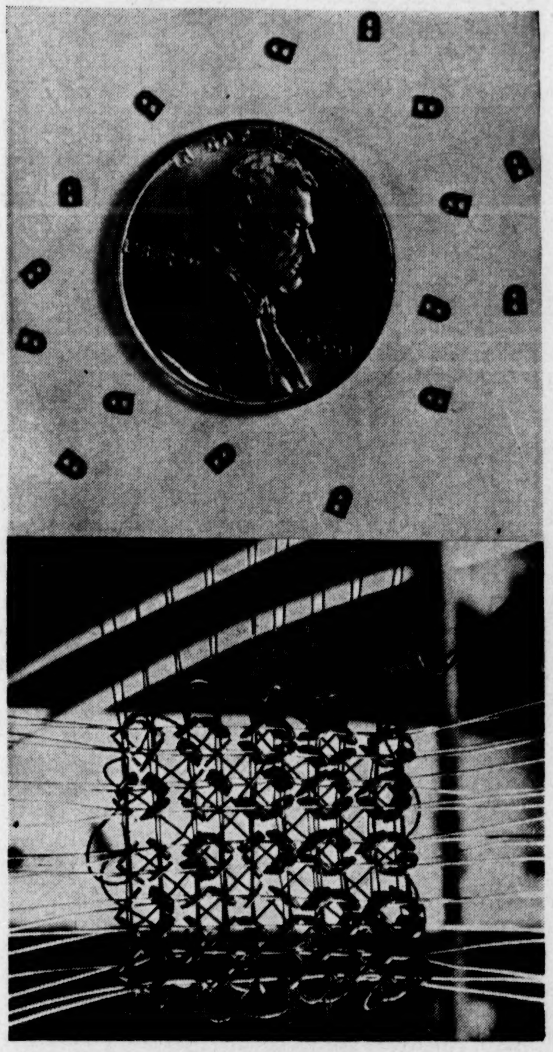
Intelligence Group Incorporated in ARC

Washington—Georgetown Research Project, associated with the Graduate School of Georgetown University since 1951, has joined the Atlantic Research Corp. as a military intelligence and social science research group.

Dr. Hans W. Weigert, who formed the 17-man team 10 years ago, will continue as director. In the past, the project has performed extensive research in various areas of military intelligence under contracts with Army and USAF.

AVIONICS





DIGITAL DATA PROCESSOR for NASA's Orbiting Astronomical Observatory, to be used to aim satellite-borne telescope and store experiment data for subsequent transmission to terrestrial stations, will be developed by International Business Machines Corp. Data processor is expected to weigh 130 lb. and use 45,000 components including 5,000 transistors. Multiple-aperture ferrite cores (top, right), wired into matrices (bottom) will store up to 204,800 bits of data and provide non-destructive readout in the IBM system.

IBM System Chosen for OAO Satellite

By Philip J. Klass

The most sophisticated digital data processing system yet attempted for non-military satellite use will be developed by International Business Machines Corp. for the National Aeronautics and Space Administration's Orbiting Astronomical Observatory (OAO).

IBM's Federal Systems Division was selected for the job by Grumman Aircraft Engineering Corp., prime contractor to NASA on the program (AW Feb. 13, p. 54).

Data Processor

The IBM data processor will serve as a control center to aim the 3,500-lb., 10-ft.-dia. satellite and its optical axis at any desired part of the celestial sphere and keep it precisely aligned. Additionally, the data processor will store instructions for subsequent experiments radioed up from ground stations and store experiment data until the satellite is in position to telemeter it back to a nearby earth station.

The system is expected to incorporate 45,000 components, 5,000 of which will be transistors, and weigh about 130 lb. To give the system and the OAO a high probability of operating for at least a year, the IBM system will use quadruple redundancy at the component level and triple redundancy at the circuit or the module level.

A new type of multi-aperture ferrite core memory will be used that permits non-destructive readout of stored data. This minimizes the possibility of error and reduces power consumption, compared with conventional core memories. Total average power consumption for the system is expected to be less than 35 watts. System will have capability of storing 204,800 bits in the data storage memory, or 102,400 bits when operated as a dual (redundant) memory to provide greater reliability.

The OAO will be the first satellite designed to probe the far reaches of space by analyzing ultraviolet radiation from stars and planets, masked from terrestrial observatories by the atmosphere, which will give earth-based scientists the ability to control or change the experiments while the vehicle is in orbit. The present NASA plan calls for the first OAO to carry an experiment, designed by the Smithsonian Astrophysical Observatory, which will map the heavens at three different ultraviolet wavelengths. Also planned for the first vehicle is an experiment by the University of Wisconsin which will use a broadband photoelectric photometer to measure intensity of ultraviolet radiation in several wavelength bands.

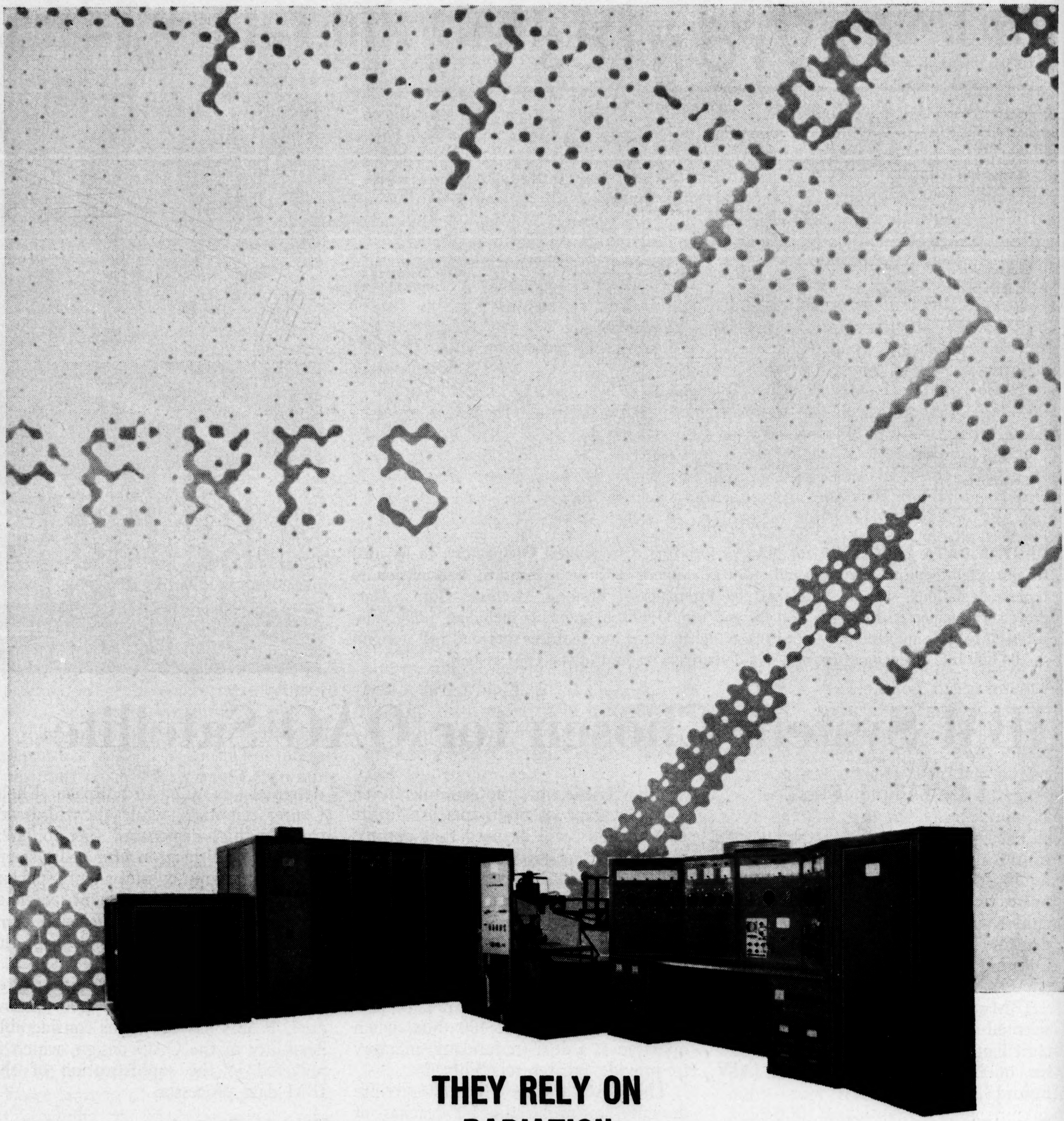
The second OAO is planned to carry a moderate dispersion spectrometer, designed by Goddard Space Flight Center scientists, while the third will carry a high-dispersion spectrometer, designed by Princeton University scientists, to examine individual spectral line radiation. Subsequent vehicles may be outfitted with television cameras to permit visual exploration of the planets.

To enable scientists to quickly alter an experiment to explore new discoveries, NASA has called for considerable flexibility in the OAO design, which is reflected in the sophistication of the IBM data processor.

Vehicle Control

Stabilization and control of the OAO attitude, which will aim the telescope mounted in the center of the octagonal-shaped satellite, will be accomplished by means of three sets of inertial wheels. Once the vehicle is in orbit, rate gyros will provide a means of sensing angular motion about all of the satellite's axes, causing actuation of appropriate inertia wheels to dump the angular momentum.

The OAO's optical axis will then be oriented to a predetermined attitude using the sun as a reference, by means of six solar sensors mounted on the satellite. Initial attitude stabilization and orientation of the satellite when it first goes into orbit are not functions assigned to the IBM data processor,



THEY RELY ON
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Radiation at Stanford (formerly Levinthal) designs and builds high-power radar and communications transmitters, modulators and power supplies. This 30 megawatt transmitter for radar and component testing is typical. It demonstrates a unique capability for solving the special problems of superpower RF.

Two major design considerations in superpower RF equipment are performance *and* safety. In this unit—as in other Radiation-built systems with peak power to 100 megawatts and frequencies to 40,000 megacycles—special circuitry operates at miscrosecond speeds to prevent damage to the equipment. It includes five sub-assemblies with remote console containing all controls, interlock indicators and monitoring oscilloscope.

This capability of Radiation at Stanford is being utilized today by many prime contractors for advanced defense systems, and by makers of high-power commercial equipment. If you work with megawatts at megacycles, you can rely on it, too, for comprehensive solutions to your problems. Write Radiation at Stanford, Dept. AW-5, 3180 Hanover Street, Palo Alto, California, for detailed information.

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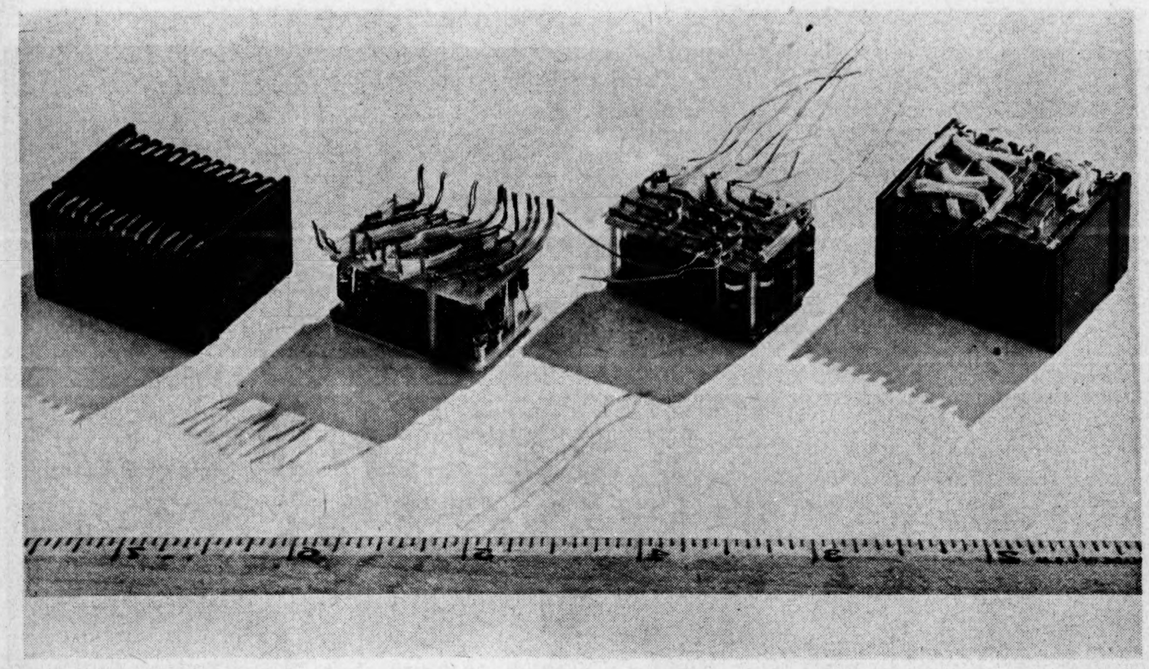


WELDED cordwood type construction will be used in OAO data processor modules to permit high component density and to increase module ruggedness and its reliability.

but will be performed by other subsystems.

Precise orientation of the OAO optical axis can be determined by two or more of six optical star trackers. Four of the star trackers will be mounted around the "waist" of the satellite, a fifth will be installed on the top and the sixth on the bottom.

Only two star fixes are needed to determine the direction of the OAO optical axis orientation. However, because the satellite attitude is stabilized in inertial space and because it will be in a low-altitude orbit (approx. 500 mi.), the earth will obscure the celestial sphere from two or perhaps three of the star trackers at any instant. This still will leave one or two "extra" star fixes which will permit more accurate determination of telescope aiming point.

Satellite Orientation

As the satellite orbits the earth, periodic reorientation of its optical axis will be required to prevent its line of sight from being obscured by the earth. Commands for these changes in satellite orientation will be telemetered from ground stations, when the OAO is overhead, and stored in the IBM data processor.

To minimize satellite-borne equipment, most of the computation will be performed by earth-based computers. For example, the number of turns of inertia wheels required to swing the optical axis to a new area of the celestial sphere will be computed on the earth and transmitted to the satellite. The data processor will initiate inertia wheel movement, keeping a count on the number of revolutions and halting the wheel(s) when OAO's optical axis has been properly reoriented.

Once the satellite has been reoriented, it may be necessary to shift the star trackers to a new set of stars to prevent loss of spatial reference due to earth obscuration of the celestial sphere. If so, commands for the required reorientation of the trackers also will be calculated by a terrestrial computer and telemetered to the vehicle. The data processor will then initiate signals which will cause the appropriate star tracker(s) to shift through the required angles to lock onto new stars.

To assure that the OAO receives telemetered commands correctly, they will be transmitted twice by the ground station, and repeated back by the OAO transmitter for checking against the transmitted command.

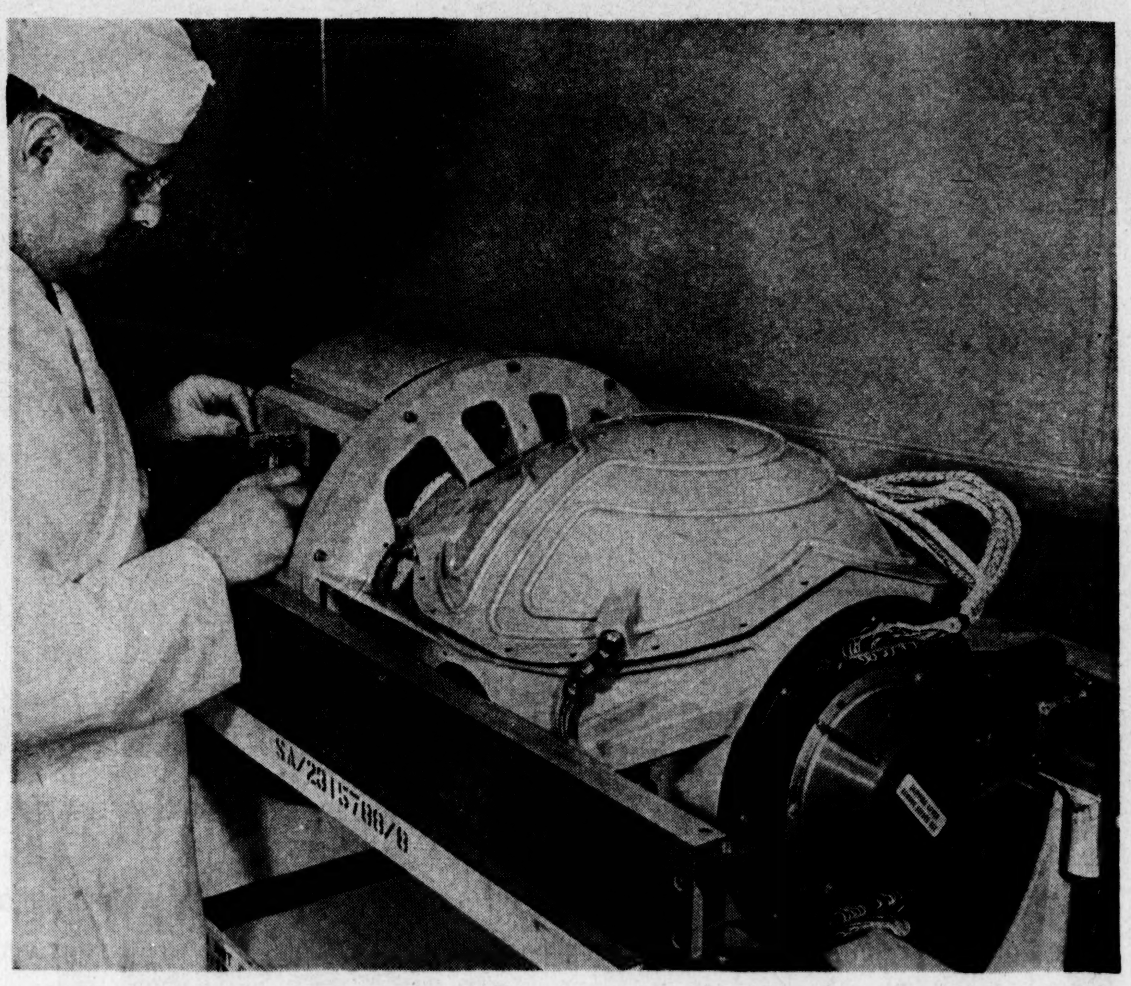
These commands, or OAO experiment program, are stored in a 256-word ferrite core memory in the data processor.

The measurements made by the experiment subsystem, aboard the satellite, will be routed to and stored by the 204,800/102,400 bit ferrite core memory, referred to as the data storage subsystem. When the satellite passes near a terrestrial station and receives an appropriate command, the data processor initiates readout of the stored data and routes it to the satellite's telemetry transmitter. The entire memory can be read out twice in 15 sec., IBM says.

Satellite Status

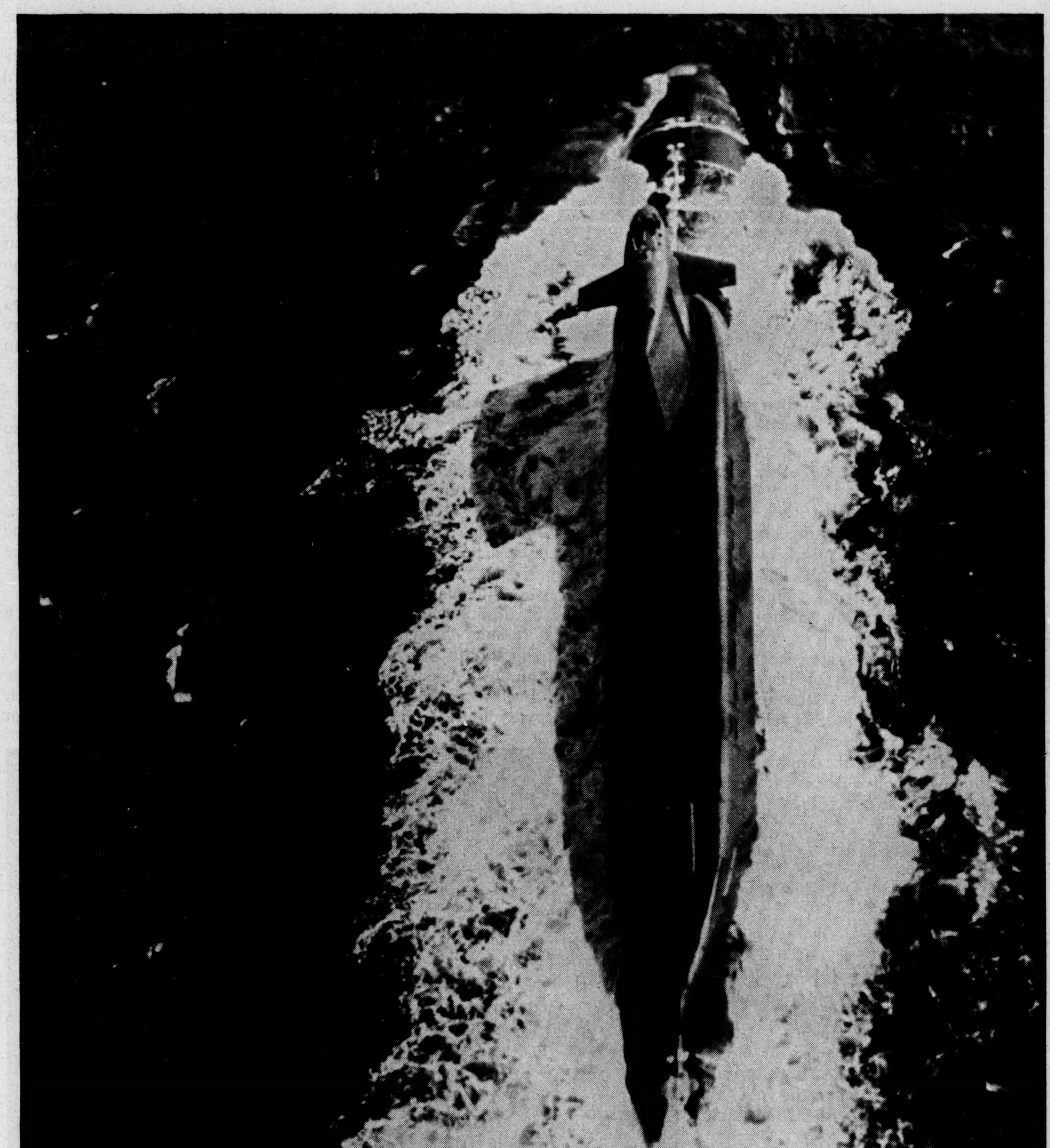
Periodically the data processor also will record information on the status of the satellite itself—such things as satellite skin temperature, internal temperatures and power supply voltage. This status data, recorded in the same memory as experiment data, also will be read out and telemetered down to a terrestrial station.

The IBM data processor includes a timing generator, or clock, which controls all sequencing aboard the satellite. For simplicity, the clock will operate on the basis of a 64-sec. "minute" which is more easily computed by a system



Polaris Mk. I Inertial Guidance Package

Polaris Mk. I inertial guidance system, developed by Massachusetts Institute of Technology and produced by General Electric's Ordnance Dept., includes three-gyro stabilized platform (foreground) and digital computer/control subsystem (rear). Recent $4.5 million award to GE brings its total Polaris program contracts to date to $120 million. Advanced Mark II guidance, for 2,500-mi. Polaris, is now under development at M.I.T.



DATICO ON BOARD:
SIX MONTHS FROM CONTRACT TO COUNTDOWN

Just six months following contract award, Northrop began deliveries of Datico automatic checkout equipment for use in the Navy's Polaris Fleet Ballistic Missile program. Datico is used in factory, depot, tender, and submarine operations.

Datico is a digital automatic tape checkout system with a wide variety of applications. Its successful integration by Northrop into the Polaris and other major weapons systems demonstrates that the same basic Datico equipment can be used at all levels of maintenance and operation, utilizing the same test standards and methods and operated by personnel with the same basic training.

Northrop is at work on more advanced versions of Datico to extend its capability to an even wider range of military and industrial systems.

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NORTHROP

which operates in binary numbers.

The same type of multi-aperture reluctance switch (core), called MARS for short, will be used both for the 256-word command storage and the larger experimentation and status data storage.

The device was developed recently by IBM's Space Guidance Center at Owego, N. Y., which will build the OAO data processor.

Device's Advantage

The rotating drum type memory, widely used for terrestrial computers, is not too attractive for space use because of its angular momentum and the problems of operating and lubricating rotating machinery continuously in a vacuum. Conventional ferrite core memory elements have the disadvantage, for space, that readout of stored information erases the data from the memory. If data is required for subsequent use, it must be regenerated each time the memory is interrogated, which consumes power, requires added circuitry and risks the possibility of error. The nondestructive readout capability of the new IBM multi-aperture cores gets around this problem.

Another advantage is that if interference should prevent a terrestrial station from receiving data telemetered from the OAO, the station can obtain a repeat readout and transmission.

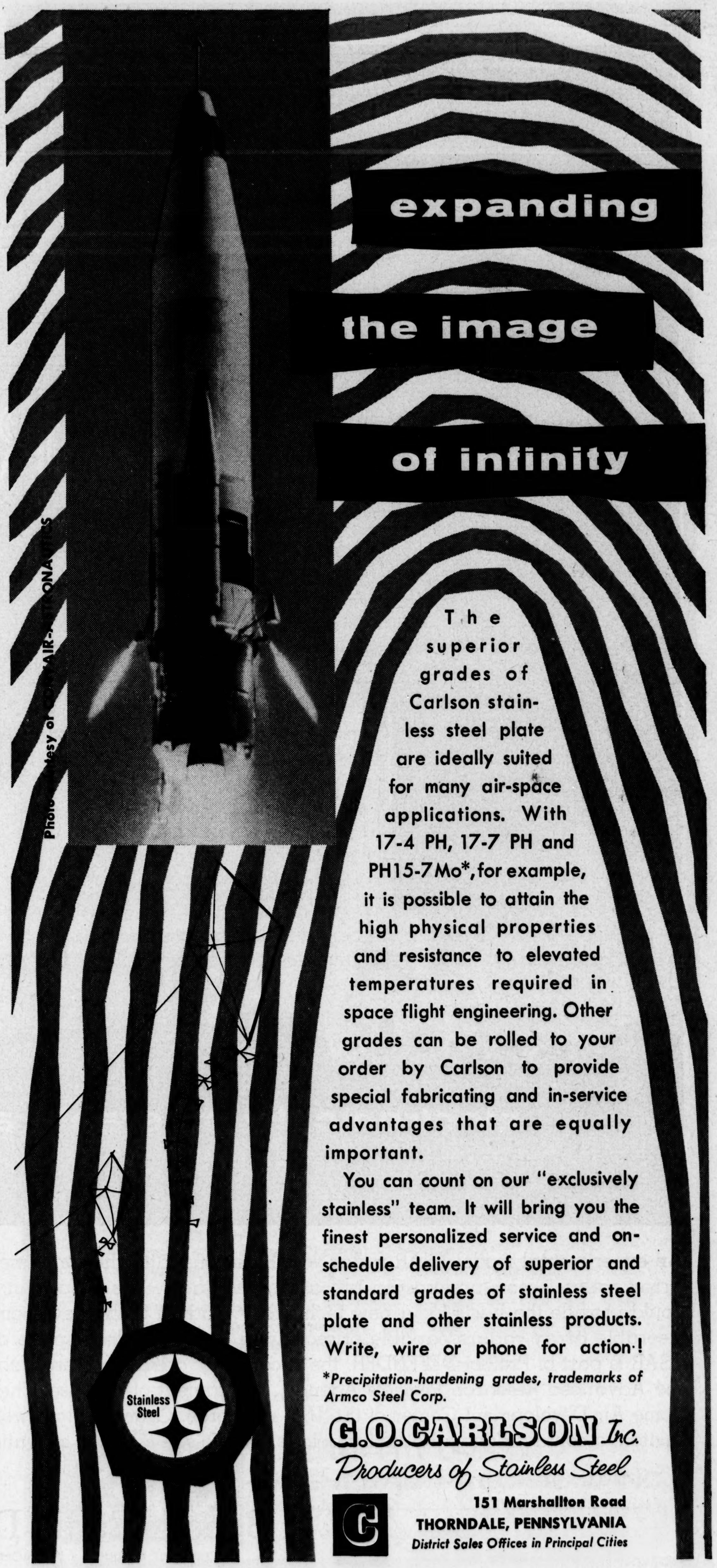
System Redundancy

Both component and module redundancy are planned for the data processor. For components such as resistors, whose customary failure mode is to open-circuit, four resistors will be used in parallel and the circuit designed so that it will still operate despite open-circuit failure of three of the four resistors. For components such as capacitors, transistors and diodes, whose failure may be either an open or a short circuit, four components will be connected in a series-parallel ("H") group so that failure of any one component will not cause failure of the circuit.

For analog type circuits, such as sense-amplifiers and delay line amplifiers, three identical circuits will be operated in parallel. If there is any significant difference in the output of the three amplifiers, the two whose outputs "agree" are used and the "dissenter" amplifier output is ignored.

Welded cordwood type construction will be employed in the plug-in modules that make up the system, to achieve high component density.

IBM expects to deliver a non-flyable model of the OAO data processor to Grumman in April, 1962. The company's contract also calls for it to build a flyable equipment for subsequent delivery.



The superior grades of Carlson stainless steel plate are ideally suited for many air-space applications. With 17-4 PH, 17-7 PH and PH15-7Mo*, for example, it is possible to attain the high physical properties and resistance to elevated temperatures required in space flight engineering. Other grades can be rolled to your order by Carlson to provide special fabricating and in-service advantages that are equally important.

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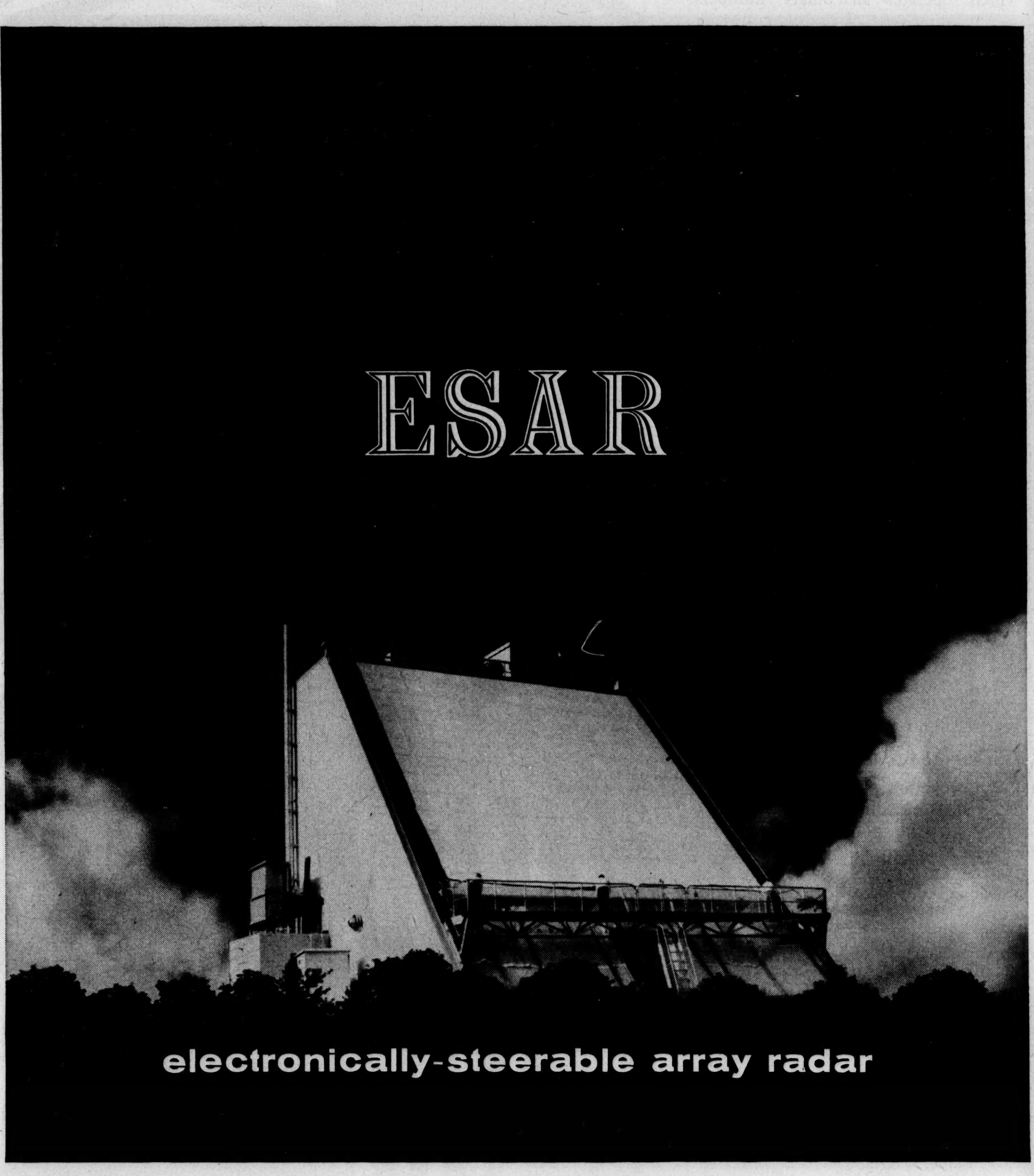

An experimental model ESAR radar which demonstrates the fundamental aspects of electronically-steerable array radar is now undergoing test at Bendix Radio. The successful culmination of this experimental effort could provide the basis for a new technology leading to the development of multiple function, electronically-steerable array radars capable of searching, tracking, deep space communications and command control. ESAR is part of Project DEFENDER, the program of advanced research in ballistic missile defense directed by the Advanced Research Projects Agency, Department of Defense. The ESAR contract is administered by the Rome Air Development Center of the U.S. Air Force. Organizations working on advanced space concepts are invited to contact Bendix Radio for details, and to see ESAR in operation.

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FILTER CENTER

▶ **Space Environment Study**—Effect of different types of radiation, ranging from ultraviolet to infrared and high-energy electrons, on different semiconductor materials in a space environment will be studied by CBS Laboratories under Air Force sponsorship. Results of tests, to be conducted in vacuum and temperature conditions simulating space conditions, will be used to recommend optimum semiconductor materials for space vehicle use.

▶ **Fast Warm-up Tubes Developed**—Two new subminiature tubes, which require only five seconds to reach stable plate current, have been developed by Raytheon. One tube, the QV112, is a medium-mu triode with characteristics similar to the 6111 tube. The other, a QV113, is a sharp cutoff pentode similar to the 5702. Both operate in the VHF region at bulb temperatures up to 220C. Engineering samples are available. Raytheon Co., Industrial Components Division, 55 Chapel St., Newton 58, Mass.

▶ **French Report Doppler Tests**—Recent flight evaluation of the British Marconi doppler navigation equipment by the French Air Ministry indicated a mean groundspeed error of 0.04% at 1,000 ft., and 0.07% at 36,000 ft., manufacturer reports. When operated over calm seas (Beaufort 0-1) at 35,000 ft., maximum difference between overland and over-water measurements was 0.45%, Marconi says. Equipment drift measurements indicated a standard deviation of 0.13 deg. In 33 flights, totaling nearly 37 hr. of operation, there was no equipment failure, Marconi says.

▶ **Hound Dog Monitored by Remote Control**—Data telemetered from Hound Dog missiles undergoing flight test over the Atlantic Missile Range is being relayed instantly by leased telephone line to North American engineers at Downey, Calif. while flight is in progress. Procedure greatly accelerates engineering analysis of the performance of missile's inertial guidance system.

▶ **ECM System Under Flight Test**—The Sperry automatic AN/ALQ-27 electronic countermeasures system, originally developed for use on the B-52, will soon start flight evaluation tests aboard a KC-135 at Eglin AFB, Fla. The ALQ-27, whose planned production was canceled for economy reasons, is the first airborne ECM system designed to automatically select and control countermeasures equipment required to jam and/or deceive enemy detection and tracking radars.

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Designed for strapdown control applications, this miniature wide angle precision gyro provides accurate and reliable performance in extreme missile environments.

A newly developed high viscosity damping fluid with good low temperature characteristics permits large angular inputs without loss of reference and eliminates the need for paddle type damping devices. Low uncompensated drift levels are obtained through the use of externally controlled adjustments of mechanical mass unbalance and fixed torque drift. A unique torquer with external adjustments makes possible high torque linearity including at the "off null" position. The spin motor will operate satisfactorily from a three phase or single phase 400 cps power supply.

Actual test data taken on a group of these gyros demonstrate the capability of this device as the most accurate and stable control gyro now available. Typical test results include the following average values:

Uncompensated mass unbalance level—0.35°/hr/g avg.; Uncompensated restraint level—0.4°/hr avg.; Torquer linearity 0.017% avg. proportional from 0.1°/sec to 5°/sec.

TYPICAL CHARACTERISTICS

Angular momentum (gm cm2/sec.)		100,000
Operating temperature		180°F*
Torquer scale factor (°/hr/ma)		800
Input angle		Up to 30 degrees
Transfer function (mv/mr)		3.75 at gyro gain of 3.0
Dimensions:	lengths	3.56"
	body diameter	1.98"
	mounting diameter	2.15"
Weight		1.2 pounds

*lower operating temperature as required

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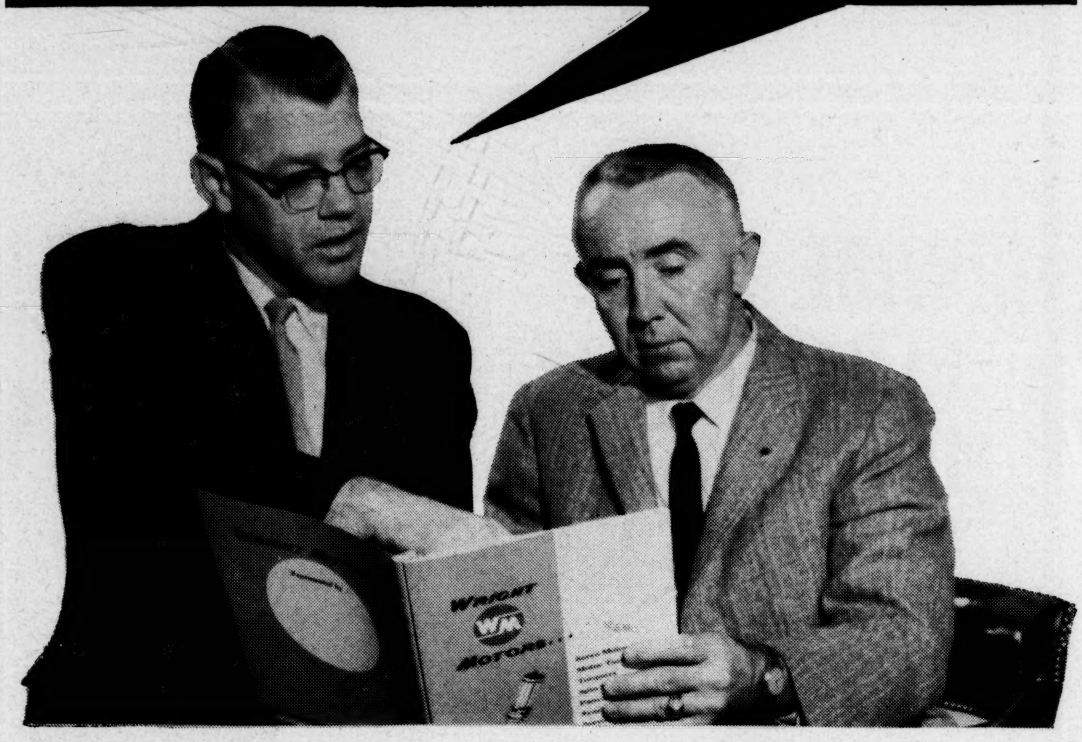

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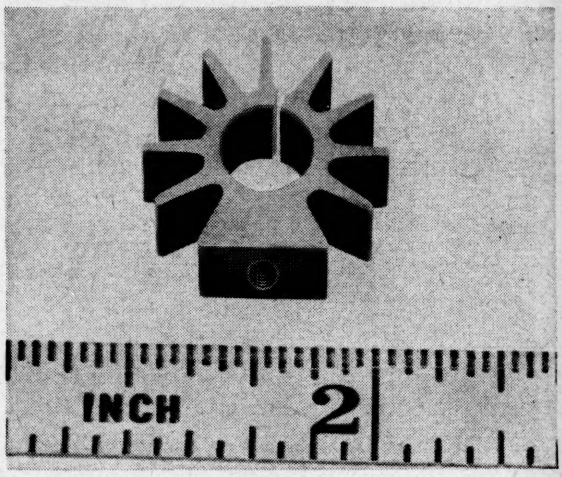
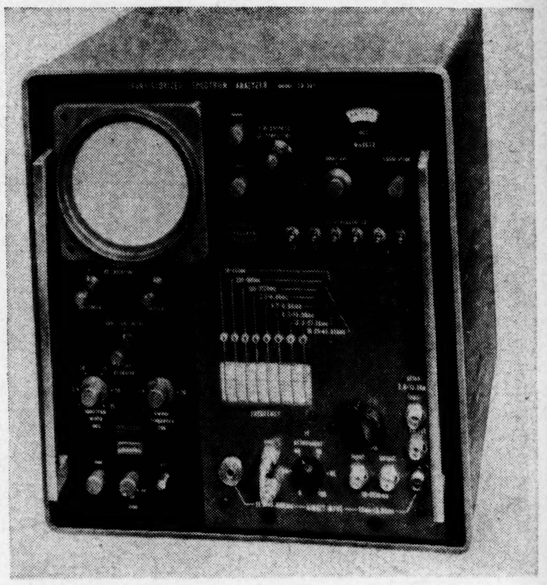
• **Photomultiplier tube aging test set,** Model 350, can check two groups of 24 tubes each sequentially, while all 48 tubes are operating continuously, by measuring anode and cathode currents of a single tube at a time. Illumination on each group of photomultiplier tubes is adjustable. Manufacturer: Automation Laboratories, Inc., 179 Liberty Ave., Mineola, L. I., N. Y.



• **Transistor heat radiator,** Type 3AL-724, for TO-18 size packages, reportedly increases transistor frequency by 25% and prevents thermal runaway. The eight-fin radiator base can be tapped for vertical or horizontal mounting on printed boards or metal chassis. Manufacturer: the Birtcher Corp., Industrial Division, 745 S. Monterey Pass Rd., Monterey Park, Calif.



• **Transistorized microwave spectrum analyzer,** Model SA-84T, covering frequency range from 10 mc. to 40,880 mc., can be used for spectral measurements, detection and identification of spurious signals, countermeasures analysis, testing microwave oscillators and similar functions. Analyzer weighs 70 lb. and operates from either 12 v.d.c. or 115 v.a.c. Single tuning unit covers the entire frequency range with a direct-reading frequency dial. Manufacturer: Polarad Electronics Corp., 43-20 34th St., Long Island City 1, N. Y.

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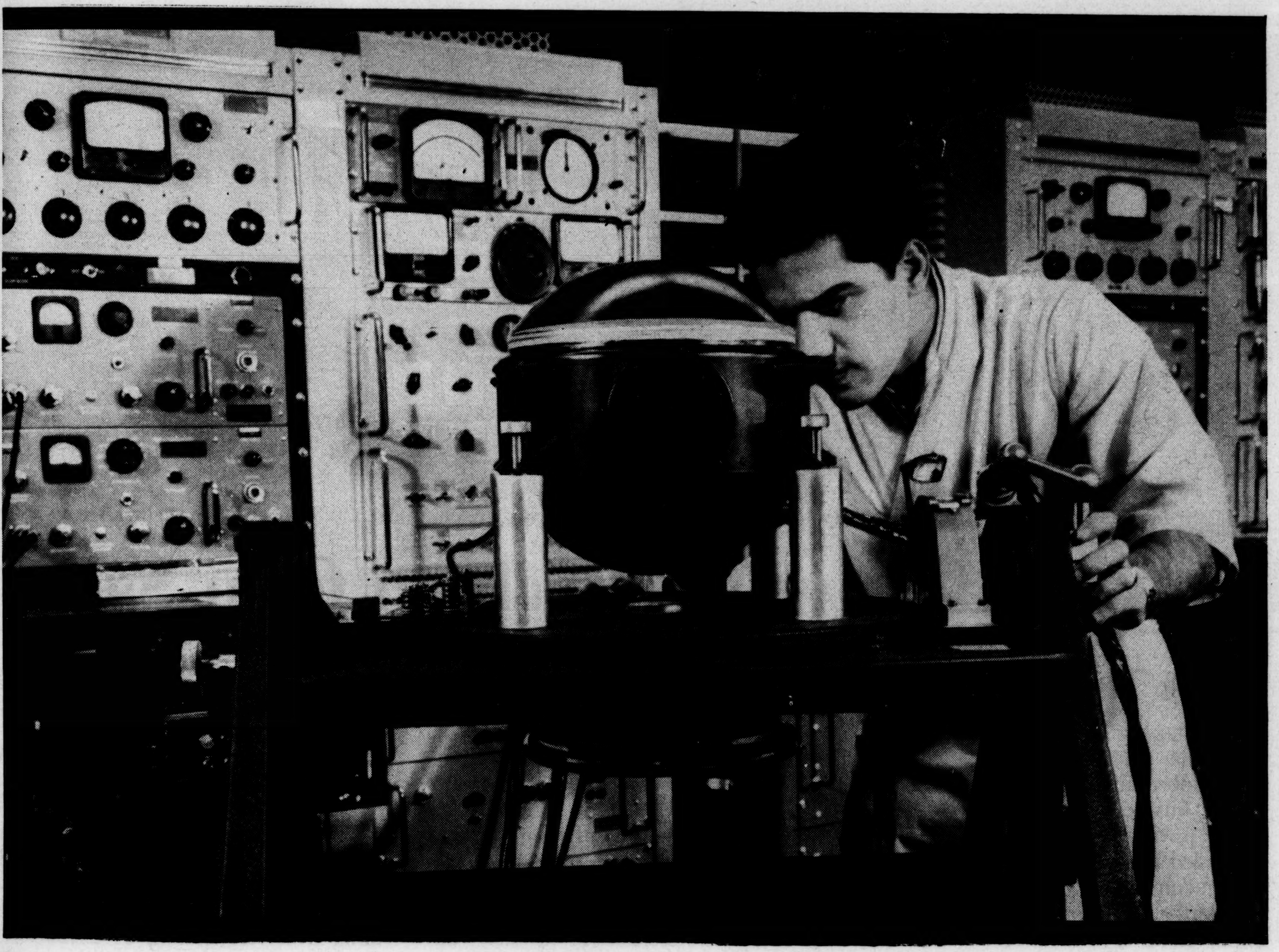

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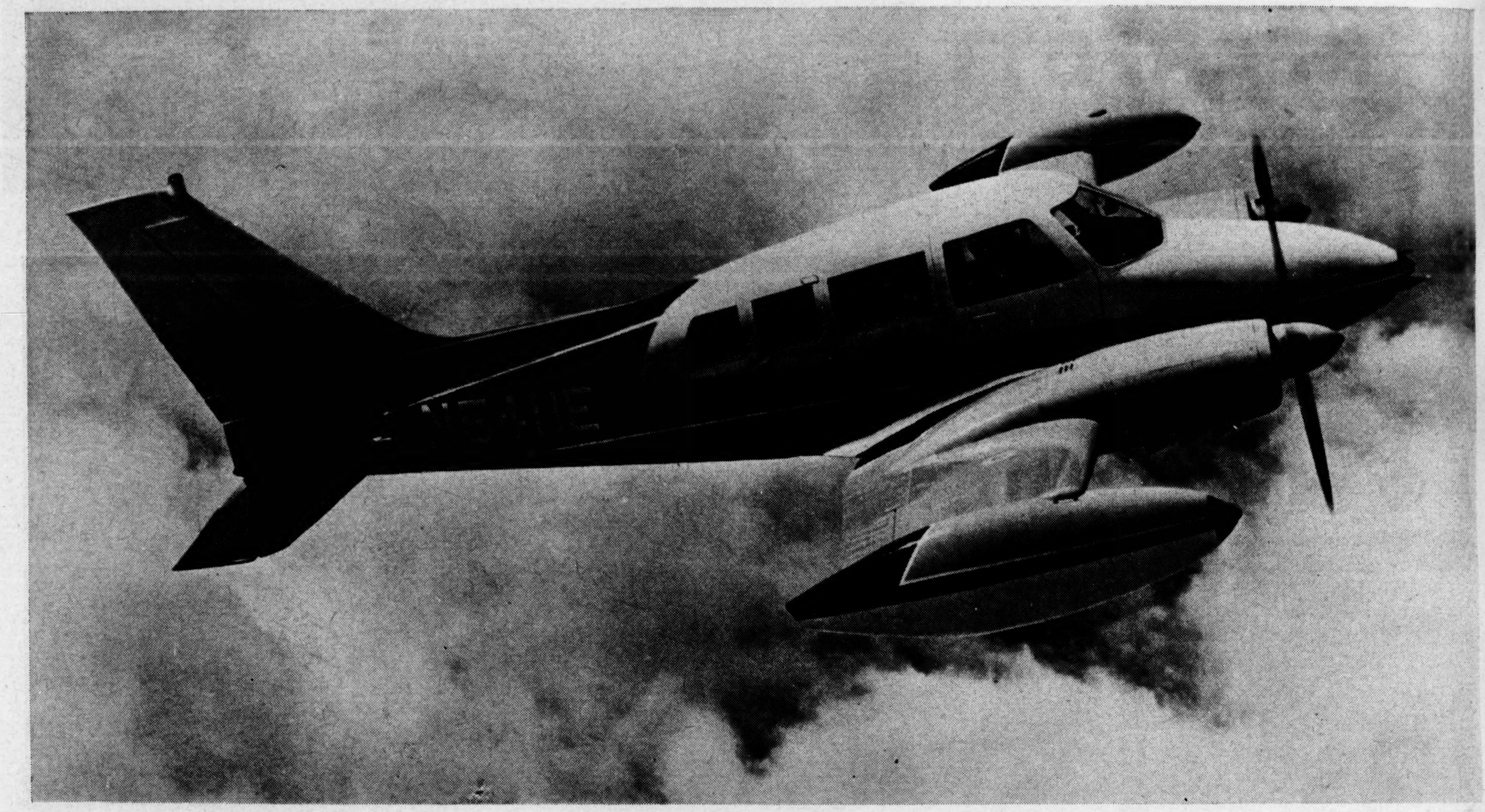


FOUR windows on each side of cabin and "sawtooth" engine cowling underside distinguish Model 320 Skyknight from lighter Model 310F.

Skyknight Unveiled Early to Gain Sales

By Erwin J. Bulban

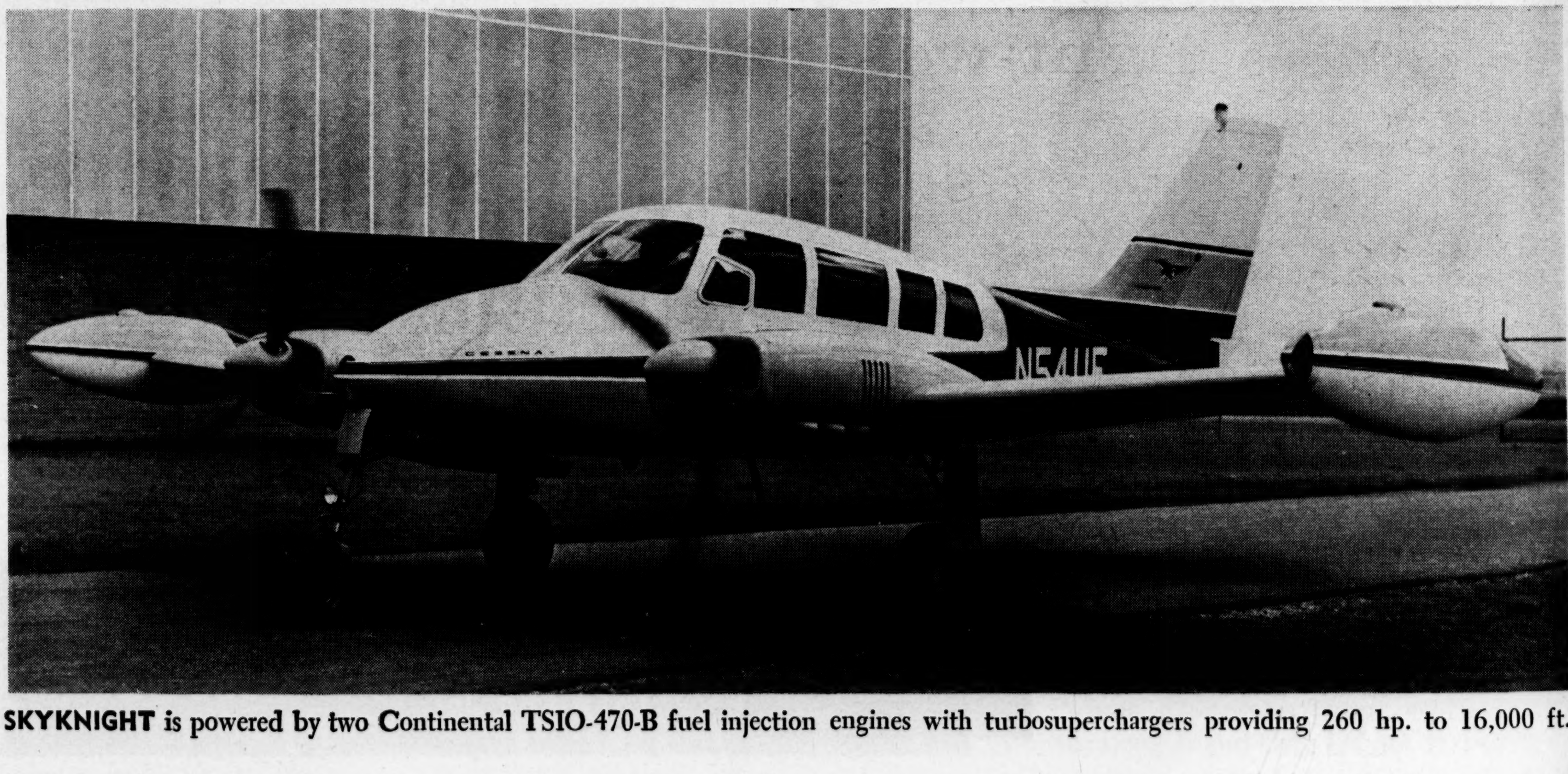
Price tag of $67,500 has been placed on Cessna Aircraft Co.'s new five-place turbosupercharged Model 320 Skyknight business plane (AW Nov. 14, 1960, p. 32) and first deliveries are scheduled from the Wichita, Kan., factory in August.

Cessna has departed radically from initial plans to introduce the new airplane—planned earlier for first showing with the 1962 model line this fall—and indications are that its reasons are twofold, though intermeshing. First, Cessna management is certain that the softness that has existed in business flying sales as a result of the U. S. recession has shown definite signs of improvement and since the airplane is ready to go, they want to strike while conditions are ripe.

Two, introduction of a new airplane at this time is a psychological sales gambit, heightening customer interest at a time when it is vulnerable to new attractions.

Plans are to send Skyknight demonstrators on a nationwide tour of the company's dealers in July.

Major feature of the new, higher-performance version of the Cessna 310F is use of turbosupercharged engines—260-hp. Continental TSIO-470-B—providing a service ceiling of 27,200 ft., with powerplants maintaining full



SKYKNIGHT is powered by two Continental TSIO-470-B fuel injection engines with turbosuperchargers providing 260 hp. to 16,000 ft.

power up to 16,000 ft. Exhaust gas driven turbosuperchargers compress air inlet ram air for each engine, and an automatic compressor control assures optimum air intake for the engine with variations in altitude. Exhaust gases are taken to the turbosuperchargers via stainless steel tubes.

Heavier Than 310F

Although externally similar to the 310F, the Skyknight is heavier. Maximum gross weight is 4,990 lb. and empty weight is 3,190 lb., compared with the 310's maximum gross weight of 4,830 lb., empty weight of 3,040 lb.

Because the turbosuperchargers maintain constant power output up to 16,000 ft., speed at that altitude reaches a maximum of 265 mph. compared with a maximum of 245 mph. for the 310F at sea level.

Single-engine ceiling of the Skyknight at maximum gross weight of 4,990 lb. is 17,300 ft.; for the 310F at gross weight of 4,830 lb., it is 7,700 ft.

Engines are housed in low-profile nacelles measuring only 22½ in. at their deepest point. The airplane is being offered with dual generators, vacuum pumps, vacuum systems and engine-driven fuel pumps backed up by dual auxiliary electric fuel pumps, as standard equipment.

Engines are fitted with manually-operated cowl flaps, and with butterfly valves housed in "sawtooth"-type fairings on the underside of the cowlings.

Competitive Aircraft

Indications are that the Skyknight is designed to give Cessna dealers a product directly competitive with the six-place Beech J50 Twin-Bonanza and seven-place Aero Commander 680F, both of which also are supercharged, and is a further example of business aircraft manufacturers' efforts to supply a growing demand for airplanes capable of operating at altitudes over 10,000 ft. for long distances.

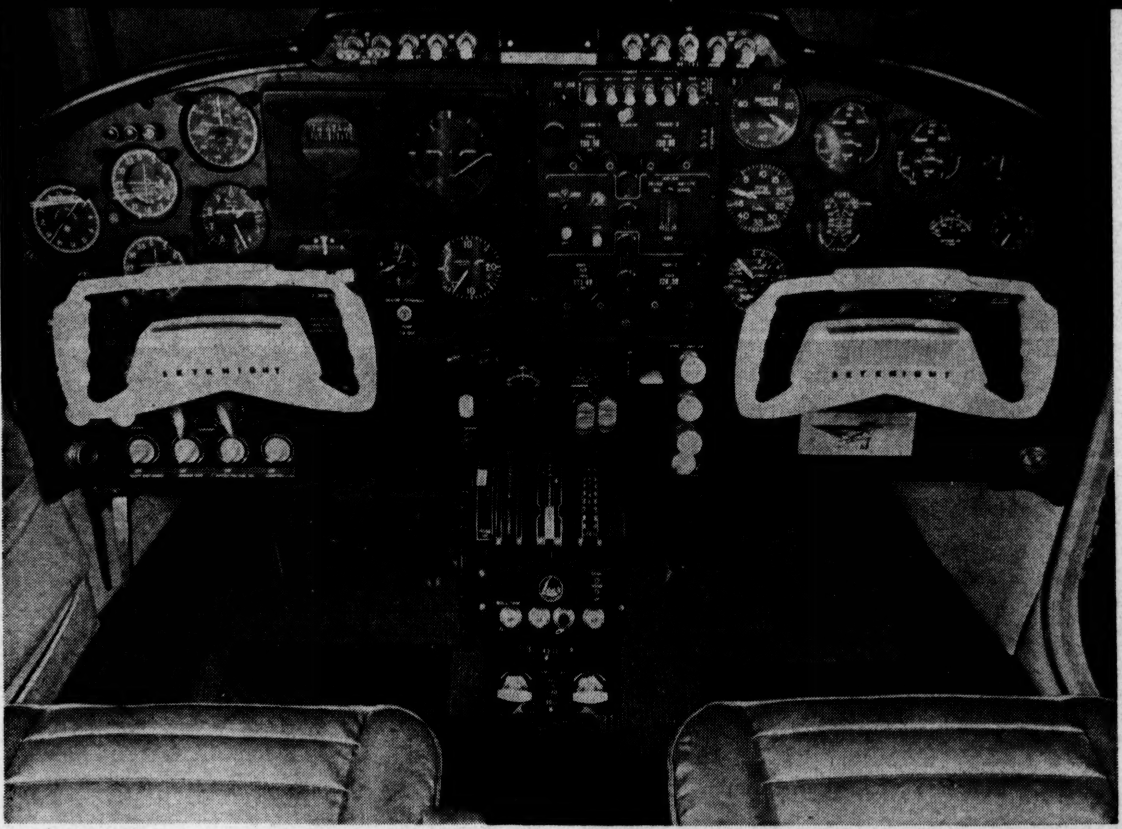
The cabin is several inches deeper than the Model 310F. Interiors are available in four color combinations and exteriors can be finished in any of 10 different color combinations.

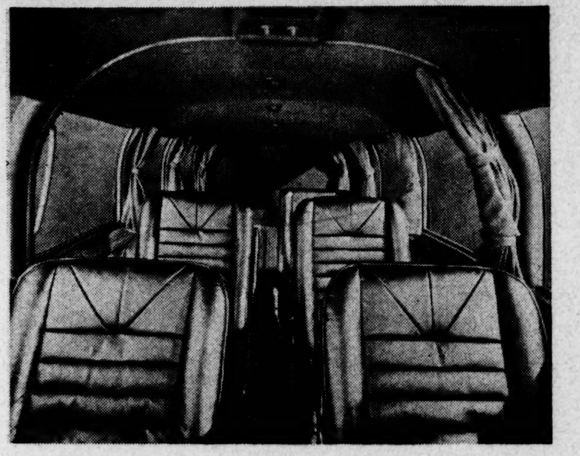
Skyknight has 3,937 sq. in. of transparent area in the cabin and cockpit. Total cabin volume is 133 cu. ft.

Skyknight's landing gear utilizes Goodyear dual-cylinder disk-type brakes with a capacity of absorbing more than 585,000 ft.-lb. of kinetic energy.

Model 310F's brakes are capable of handling about 446,000 ft.-lb.

Four seating arrangements are available—four-place with rear seats together, four-place with aisle space between rear seats, five-place with a single seat on left side behind two rear seats and three single seats plus a stretchout lounge in the rear on the left side.





PANEL layout appears to be identical with that of the Model 310F, and follows the familiar Cessna grouping of flight and engine instruments and communications equipment. Seating layout also is similar to that of the Model 310F, locating three seats on the left side and two on the right, separated by aisle. Four seating arrangements, including a lounge, will be available to Skyknight buyers. Seats move fore and aft and recline individually.

Cessna Skyknight Model 320

Gross weight	4,350 lb.	4,650 lb.	4,990 lb.
Empty weight (approx.)	3,190 lb.	3,190 lb.	3,190 lb.
Max. speed (16,000 ft.)	270 mph.	268 mph.	265 mph.
Best cruise (75% power, 19,500 ft.)	249 mph.	247 mph.	245 mph.
Best cruise (75% power, 10,000 ft.)	228 mph.	226 mph.	223 mph.
Range (19,500 ft., 100 gal.)	864 mi./247 mph.	860 mi./244 mph.	855 mi./242 mph.
Range (10,000 ft., 100 gal.)	794 mi./225 mph.	792 mi./223 mph.	790 mi./221 mph.
Range (19,500 ft., 130 gal.)	1,136 mi./247 mph.	1,122 mi./244 mph.	1,100 mi./242 mph.
Range (10,000 ft., 130 gal.)	1,035 mi./225 mph.	1,030 mi./223 mph.	1,025 mi./221 mph.
Max. range (25,000 ft., 100 gal.)	1,184 mi./199 mph.	1,144 mi./203 mph.	1,100 mi./207 mph.
Max. range (10,000 ft., 100 gal.)	1,090 mi./163 mph.	1,055 mi./165 mph.	1,015 mi./171 mph.
Max. range (25,000 ft., 130 gal.)	1,537 mi./199 mph.	1,487 mi./203 mph.	1,430 mi./207 mph.
Max. range (10,000 ft., 130 gal.)	1,415 mi./163 mph.	1,371 mi./165 mph.	1,320 mi./171 mph.
Two-engine service ceiling	28,700 ft.	28,000 ft.	27,200 ft.
One-engine service ceiling	20,800 ft.	19,500 ft.	17,300 ft.
Two-engine rate of climb (sea level)	2,250 fpm.	2,050 fpm.	1,850 fpm.
One-engine rate of climb (sea level)	620 fpm.	520 fpm.	400 fpm.
Baggage	200 lb.	200 lb.	200 lb.
Wing loading	24.1 psf.	26.4 psf.	28.5 psf.
Power loading	8.1 lb./hp.	8.8 lb./hp.	9.6 psf.

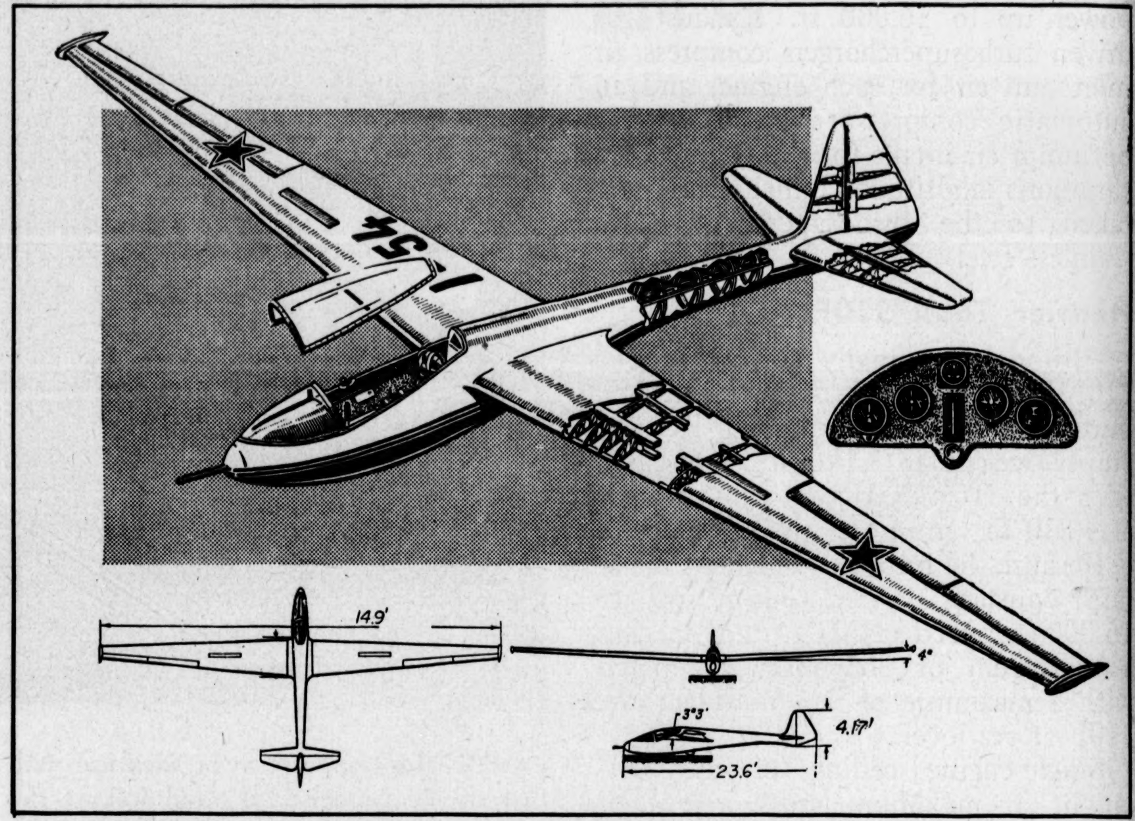
Notes: All ranges are with no fuel reserve. Single-engine ceiling increases more than 550 ft. each 30 min. of flight.

BK-6 Glider Details Revealed by Soviets

Russia has revealed design details and performance data on its new, single-place BK-6 "Neringa" glider.

Built in Vilnius, Lithuania, by Balis Karvelis, the standard-class craft passed its flight tests last summer. However, a number of modifications are planned before the BK-6 is used as a trainer by the Soviet Union's semi-military DOSAAF sports organization.

Designer Karvelis, who built the well-known BK-4 "Kaunas" glider in 1957, started work on the high-performance BK-5 and the BK-6 in the fall of 1959. Actual construction work on the BK-6 was turned over to the Public Flying Club of the Lithuanian Soviet Socialist Republic's Council of the National Economy.



BK-6 NERINGA glider, designed by Balis Karvelis, passed flight tests last summer.

Specifications for the BK-6 include: wingspan, 48.9 ft.; wing area, 132.4 sq. ft.; wing aspect ratio, 18; wing chord at fuselage, 4.26 ft.; wing chord at tip, 1.31 ft.; angle of attack, 3 deg. 3 min.; dihedral, 4 deg.; aileron span, 12.2 ft.; aileron area, 14.85 sq. ft.; horizontal tail surface span, 9.8 ft.; horizontal tail surface area, 16.9 sq. ft.; elevator angle, plus or minus 30 deg.; height of vertical tail surface, 4.17 ft.; vertical tail surface area, 8.86 sq. ft.; rudder angle, plus or minus 30 deg.; length of glider, 23.6 ft.; maximum fuselage mid-section area, 4.63 sq. ft.

Performance data includes: maximum towing speed behind aircraft, 87 mph.; landing speed, 35.4 mph.; minimum sinking speed, 2.5 fps. at 43.5 mph.; best gliding ratio at 56.5 mph., 28.

Maximum cockpit width for the BK-6 is 22.4 in. and height is 37 in. Cockpit is designed to accommodate a back-type parachute. Space behind the pilot accommodates radio, barograph, baggage.

Instrumentation includes an altimeter, speed indicator, compass and electric turn and bank indicator.

Weight of the glider is 511.5 lb. empty, and 728 lb. loaded.

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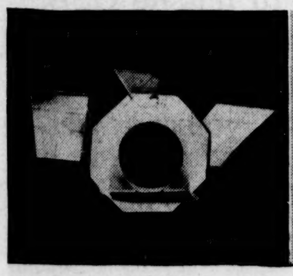
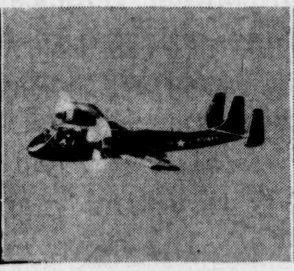
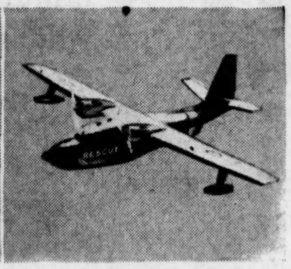

OAO
Orbiting Astronomical
Observatory


AO-1 MOHAWK
Observation-
surveillance

GULFSTREAM
Corporate and
military transport


ALBATROSS
Amphibian
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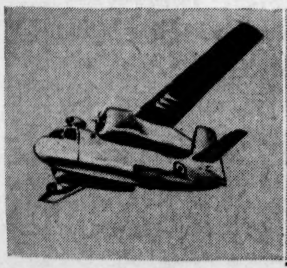
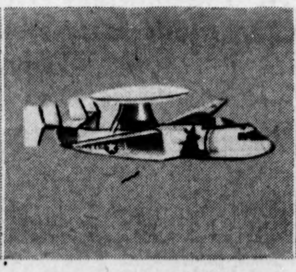
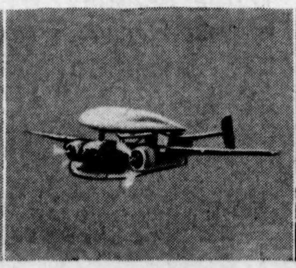
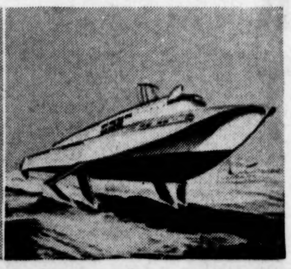

S2F-3 TRACKER
Anti-submarine
warfare


W2F HAWKEYE
Airborne
early warning


WF2 TRACER
Airborne
early warning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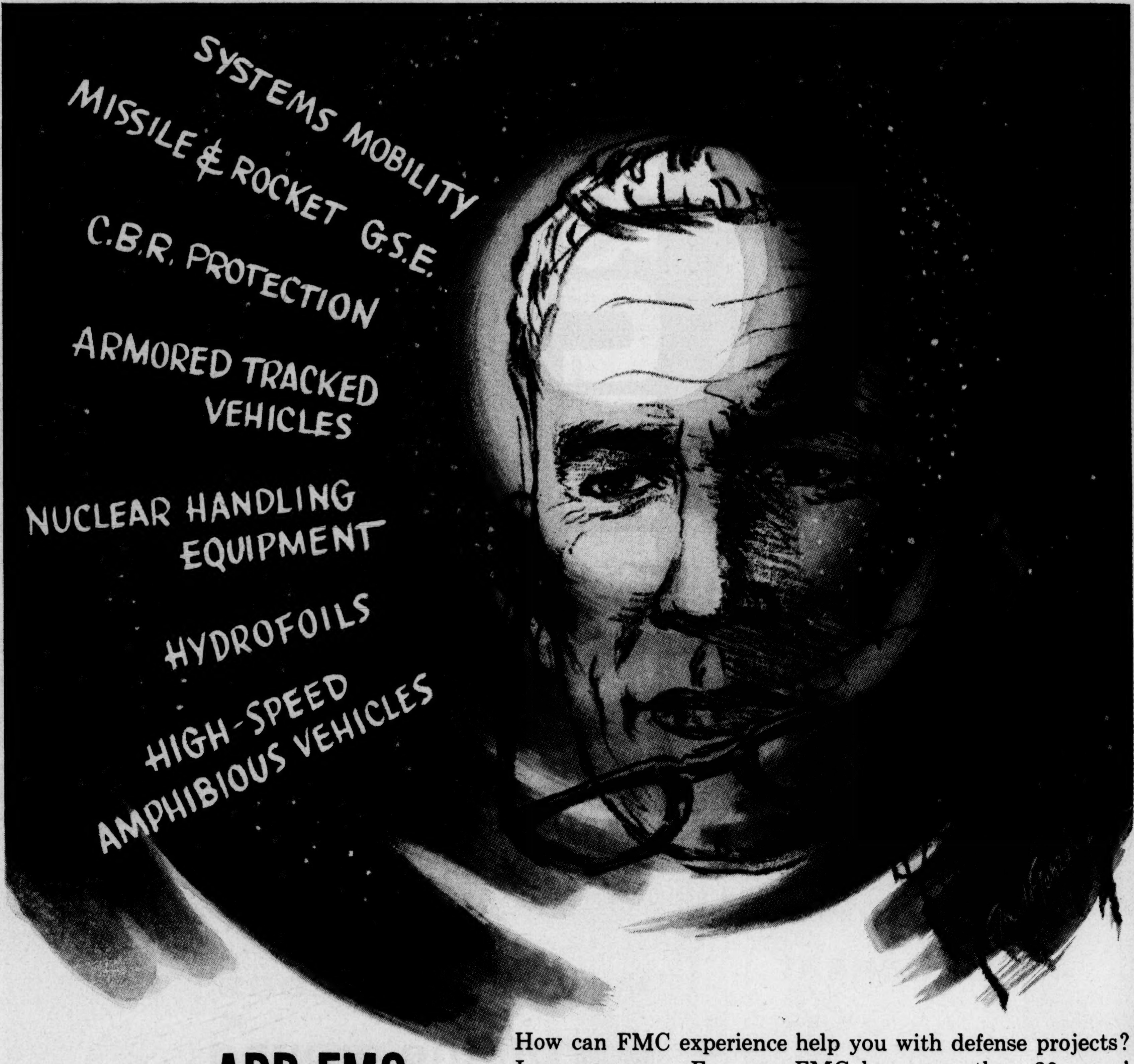
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PRIVATE LINES

Piper Aircraft Co. delivered 235 airplanes valued at $2,705,627 in factory billings during April. Total included: 1 PA-18 "95" and 16 PA-18 "150" Super Cubs, 112 PA-22 Colts, 1 PA-22 Tri-Pacer, 14 PA-23 Apaches, 11 PA-23 Aztecs, 18 PA-24 "180" and 38 PA-24 "250" Comanches, and 24 PA-25 Pawnees. This brings Piper deliveries for first four months of 1961 to 968 aircraft having a total factory billing value of more than $11.8 million. Two-place Piper Colt deliveries accounted for 447 of the total units in this period.

Beech Aircraft Corp. has introduced a new air education approach by presenting a special program on business aviation before the student body of St. Louis University's Parks College of Aeronautical Technology. Wyman L. Henry, Beech vice president-marketing, said the primary objective of the program is to put business aviation in its proper perspective, enabling students to better understand the vital role of private planes in American industry by equating business flying in relation to the total aerospace industry. Also it will assess the impact of business flying on the national economy as an essential, productive working tool of business and industry.

Breguet 905 Fauvette glider has been issued a Certificate of Airworthiness by Federal Aviation Agency. The Fauvette already has a Canadian certificate.

Piston Outlook

Oklahoma City, Okla.—Piston-powered Aero Commander business planes will stay in the company's line for the foreseeable future, complementing the turbojet line initiated by the Model 1121, according to Vice President-Engineering Ted Smith. He does not envisage use of turboprop engines for the Commander because of his feeling that they pose complexity and cost problems that outweigh possible benefits of turbine power.

Considerable growth and market potential still lie ahead for the piston Commanders, company officials indicate, including pressurization, "stretching" fuselages to provide more capacity, and using larger engines. Indications are that a pressurized version of the 680F, with the new 500-hp. eight-cylinder Lycoming flat engines, will be available in the future.

The company announced recently a new version of the Model 680F—available with or without cabin pressurization. Pressurized model, the 680FP, adds $45,000 to the basic $113,000 cost of the aircraft.

SILICONE NEWS from Dow Corning

DOUGLAS DC-8

Photo courtesy of Douglas Aircraft Company

Fuel Resistant O-rings for Jets

The DC-8 Jetliner uses more than 500 flexible couplings on fuel lines. Leakage at any coupling is prevented by two rubber O-rings that must retain their rubbery properties and continue to seal as an O-ring should, despite constant contact with jet fuel.

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PROBLEMATICAL RECREATIONS 67

One of the largest known primes is $2^{3217} - 1$. Assume that it requires a human being a year to calculate each digit of this number. Who, if anyone, would have been capable of completing the job? *—Contributed*

The capability of the Data Systems Lab of Litton Systems has produced the highly successful Marine Tactical Data System, a digital computer-centered system using CRT and numerical displays, and advanced read-in/read-out equipment. This capability can be applied to your data systems problems.

ANSWER TO LAST WEEK'S PROBLEM: It is quickly seen that the club must have more than the 4 members named. The easiest method is to start building up the committees, and the solution is found to be 7 members and 7 committees, which can be designated 123, 145, 167, 246, 257, 347, and 356.

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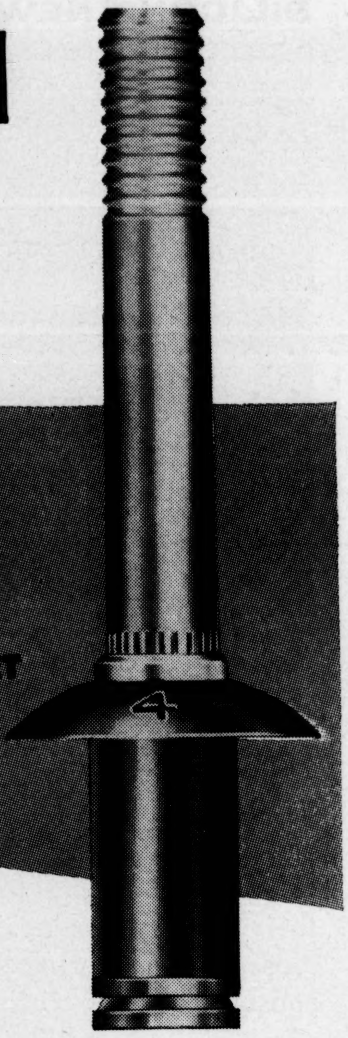
Beverly Hills, California

SOLID RIVET STRENGTH WITH BLIND RIVETS

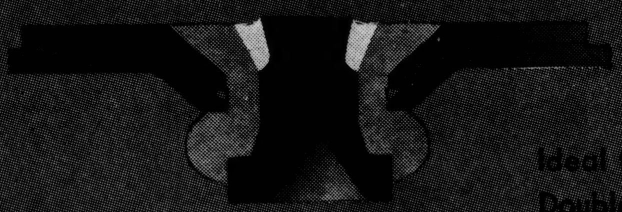
CHERRYLOCK RIVETS for Your Difficult Solid Rivet Applications



BULBED CHERRYLOCK

ONLY THE BULBED CHERRYLOCK RIVET GIVES YOU ALL THESE ADVANTAGES

Mechanically Locked Stem • Flush Fracture (No Stem Trimming) • Positive Clamp-Up • Full Grip Range • Complete Hole Fill • Minimum Blind Side Clearance • Positive Visual Inspection (Grip Length Marked on Head)



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* Patent Pending

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WHO'S WHERE

(*Continued from page 19*)

Honors and Elections

Dr. Lewis M. Branscomb, chief of the Atomic Physics Division at the National Bureau of Standards, has been awarded the U. S. Department of Commerce Gold Medal for Exceptional Service for ". . . development of basic knowledge of the atomic processes of stellar atmospheres, the terrestrial ionosphere, and interplanetary space."

Francis T. Fox, general manager of the Los Angeles Department of Airports, has been named vice president of the Western Region of the National Aeronautic Assn.

Air Marshal Sir Owen Jones has been elected president of the Royal Aeronautical Society for 1961-62.

Changes

Milton Beilock, assistant project manager-Surveyor, Jet Propulsion Laboratory, California Institute of Technology, Pasadena.

A. W. E. Houghton, assistant managing director, Vickers-Armstrongs (Aircraft) Ltd., Weybridge, England. Sir **Geoffrey Tuttle** succeeds Mr. Houghton as general manager.

Duncan G. Wright, Jr., manager of United Technology Corp.'s technical liaison office in Huntsville, Ala.

C. L. Burton, development for aerospace and military equipment, Aluminum Co. of America, Pittsburgh, Pa.

Harry A. Sosnoski, manager-planning for defense electronic products, Radio Corp. of America, New York, N. Y.

Dr. Robert D. Schultz, in charge of the newly established electro-physical laboratory, North American Aviation's Space and Information Systems Division, Downey, Calif.

M. W. Hunter, deputy chief engineer-space, and **C. S. Perry,** deputy chief engineer-missiles, Douglas Aircraft Co.'s Missiles and Space Systems Engineering Department, Santa Monica, Calif. Also: **G. V. Butler,** assistant chief engineer-space; **A. J. Carah,** assistant chief engineer-missiles.

Austin M. Elliott, director of operations, McCormick Selph Associates, Hollister, Calif.

Robert J. Sullivan, manager of liaison engineering in Europe for Fairchild Control Corp., a subsidiary of Fairchild Camera and Instrument Corp., Hicksville, N. Y.

Lyman A. Bullard, military sales manager, Safe Flight Instrument Corp., White Plains.

Stanley W. Tarnoff has joined Loral Electronics Corp.; his headquarters will be in Dayton, Ohio.

Melbourne J. Myers, manager, USD-7 program for development and design of airborne electronic equipment, Mountain View (Calif.) Operations of Sylvania Electric Products, Inc., succeeding **Robert R. Goldsborough, Jr.,** now manager, Engineering Operations Department, Mountain View Reconnaissance Systems Laboratory.

E. L. Stone, chief of the Small Business Office, Los Angeles Army Ordnance District.

Lt. Col. Sid Spear, chief of the Air Force News Branch, Office of Assistant Secretary of Defense (Public Affairs). Col. Spear is former information officer at Air Force Missile Test Center.

General Dynamics Jet Writeoffs Continue

General Dynamics Corp. continued to make provisions for costs of its jet transport programs in its first quarter statement, and Chairman Frank Pace, Jr., warned stockholders that writeoffs on the program are likely to increase proportionately later (AW May 8, p. 45).

The company reported net income of $4,194,076 for the quarter compared with $6,164,175 for the same 1960 period. Sales increased from $473,368,568 in the 1960 first quarter to $507,524,954.

How much earnings will be affected cannot be determined, Pace said, until all flight testing of the Convair 990 is done and certification is completed later this year. Other financial reports:

- **Lockheed Aircraft Corp.** earned $4.4 million or 59 cents a share on sales of $336 million for the first 1961 quarter, compared with $2.7 million or 37 cents a share on sales of $340 million for the same period last year. Chairman Robert E. Gross forecast total earnings of between $21-23 million for 1961.
- **Martin Co.** reported first quarter net income of $4,914,690 on sales of $198,248,575 compared with last year's first quarter results of $3,488,112 and $140,839,907. Earnings per share increased from 57 cents to 79 cents.
- **Chance Vought Corp.** reported net income of $949,270, equal to 79 cents a share for the first quarter of 1961, compared with $883,162 or 74 cents per share in the same period last year. Federal income taxes for the first quarter of 1961 have been accrued at 54% of consolidated taxable earnings, since the company plans to file a consolidated return for the year. This decreased provision for federal taxes by $280,000, amounting to 23 cents per share. Consolidated sales for the period totaled $45,511,335 compared with $62,557,198 in the same period in 1960, the decline attributed principally to scheduled reductions in Crusader deliveries.
- **United Aircraft Corp.** and its domestic subsidiaries' shipments for the first quarter ended Mar. 31, 1961, amounted to $277,646,010 compared with $273,904,687 for the same period last year. Net income for the quarter was $2,015,450 or 26 cents per common share as compared with 1960 first quarter earnings of $6,431,223 or 95 cents per share of common stock.
- **Fairchild Engine and Airplane Corp.**, in keeping with its prediction that 1961 would be a profitable year, reported first-quarter earnings of $885,000 or 29 cents a share on sales of $18,584,000, but cautioned that these figures should not be used as a basis for full-year earnings estimates. Fairchild lost $326,000 or 11 cents a share on sales of $23,542,000 in the first quarter of 1960. Company name was changed to Fairchild Stratos Corp. May 15.
- **Ling Temco Electronics** first-quarter net earnings increased 95% over earnings for the first three months of 1960. Profits for the quarter ended Mar. 31 were $609,783 or 24 cents a share on sales of $34,837,500, compared with last year's first-quarter profits of $312,704 or 13 cents a share on sales of $33,640,915.
- **Republic Aviation** reported consolidated sales for the first quarter of 1961 amounted to $85,735,415. Net income after taxes was $2,679,807 or $1.87 a share. This compares with first quarter 1960 sales of $34,984,520 and a net income after taxes of $498,000 or $.35 a share.
- **Raytheon Co.** 1961 first quarter profits after taxes were $1,365,000 on sales of $138,158,000. This was equal to $0.33 per share on 3,855,045 shares of common stock after provision for preferred dividends. In the first quarter a year ago, sales were $134,752,000 and profits after taxes were $2,160,000 or $0.56 a share on 3,714,418 common shares then outstanding. Backlog at the end of the present quarter exceeded $320 million.
- **American Electronics, Inc.**, reported a first quarter 1961 net profit of $30,622 on sales of $5,441,695 or 2.6 cents per share on 1,177,708 shares of common stock outstanding on Mar. 31.
- **Electronic Specialty Co.** sales for the first quarter of 1961 were more than double the corresponding quarter of 1960: $6.1 million as against $2.5 million. Profits were $185,000 or $0.21 per share and backlog at the end of the quarter exceeded $20 million.
- **Thiokol Chemical Corp.**, 1961 first quarter net earnings of $1,044,398 represented a 28% increase over the 1960 figure of $817,820. Net sales were $41,948,941 and $41,996,134 respectively.
- **Metal & Thermit Corp.** had a net income of $256,752 on sales of $9,715,815 during the first quarter of 1961. A year ago, income was $274,191 on sales of $10,030,905.
- **International Business Machines Corp.** net earnings for the first quarter of 1961 were $48,826,669, equivalent to $2.67 a share on 18,318,918 shares outstanding. Gross income from sales, service and rentals in the U. S. was $389,062,378. During the corresponding period in 1960, net earnings were $35,178,509, equivalent to $1.92 a share on 18,280,759 shares outstanding, on a gross income of $339,852,677.
- **Twin Coach Co.** reported net earnings after taxes of $250,000 on sales of $7,952,000 in the first quarter of 1961. The previous year, the company earned $268,000 on sales of $8,555,000. Sales backlog was $30,600,000.
- **B. F. Goodrich Co.** net sales for the first three months of 1961 were $172,958,254 compared with $200,730,977 for the same period in 1960, a decrease of 13.8%. Net income for the present period was $5,763,525, equivalent to $0.63 per share, as against $9,078,543, or $1.01 per share, a year ago.
- **Cannon Electric Co.** reported consolidated net earnings of $473,211, equal to $0.31 per share on 1.5 million shares outstanding, on sales of $11,434,206, for the three months ended Mar. 31. This compares with sales of $11,271,967 and earnings of $409,284, equivalent to $0.27 per share, for the same period a year ago.
- **American Airlines, Inc.**, reported a net loss of $1,966,000 for the quarter ended Mar. 31, which included a net gain after taxes of $385,000 from the sale of property. For the same period in 1960, net loss was $453,000 (including a similar gain of $464,000.) Total revenue for the two quarters was $91,104,769 this year; $96,262,652 last year.
- **General Telephone & Electronics Corp.** total revenue and sales for the first quarter of 1961 were $287,672,000 and consolidated net income was $15,328,000, equivalent to $0.22 per share. In 1960, sales were $291,232,000 and earnings $17,534,000 or $0.26 per share. Current backlog is approximately $65 million.
- **Borg-Warner Corp.** sales for the first quarter of 1961 totaled $133,545,995, compared with $162,022,000 in the first three months of 1960, a decrease of 17.6%. Net profit was $3,624,263, equal to $0.40 a share, as against $8,319,000, equal to $0.92 a share.
- **Fairchild Camera & Instrument Corp.** reported 1961 first quarter net earnings of $877,000 on sales of $20,655,000. For the corresponding period in 1960, earnings were $801,000 on sales of $13,838,000.
- **Cubic Corp.** first quarter sales for 1961 were $2,297,198 compared with $1,703,936 in the same period last year, an increase of approximately 35%. Net earnings rose from $57,999 to $95,676.

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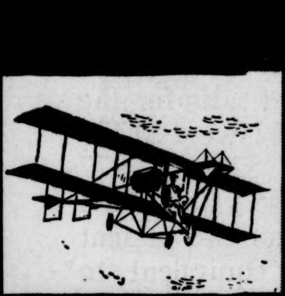
OF PROBLEMS



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■ COMMUNICATIONS ■ SPACE AND MISSILE ■ ELECTRONIC DEFENSE ■ PHYSICAL SCIENCES

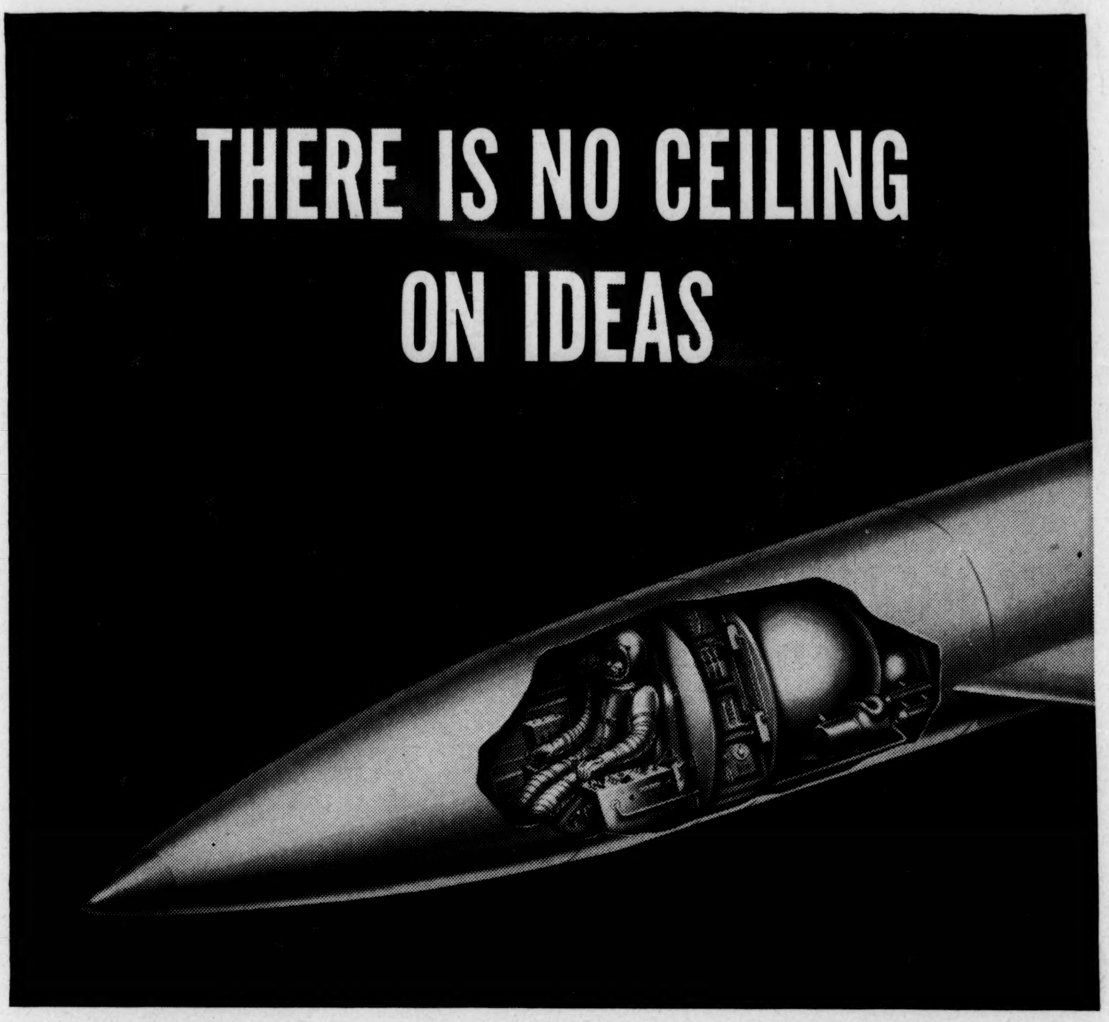
New Offerings

National Scientific Corp., Minneapolis, Minn., organized under Minnesota law in February, 1961, is a federal licensee under the Small Business Investment Act of 1958 and is registered with the SEC under the Investment Company Act of 1940 as a nondiversified, closed-end, management investment company. The company intends to invest, through the purchase of equity securities or the making of long-term notes, in small business concerns which are principally engaged in scientific research and product development programs in such fields as electronics, physics and chemistry. Offering is 1.5 million shares of common stock for public sale at $1.15 per share. Proceeds will be added to general funds and used, together with other funds, to provide equity investments and loans to small businesses, to provide financial, management and advisory services to such companies and for operating expenses.

Motorola, Inc., Franklin Park, Ill., engaged in research, development, design, manufacture and sale of electronic products and equipment of various types. Offering is $30 million of debentures due 1986, for public sale; interest rate, public offering price and underwriting terms to be supplied by amendment. Of the proceeds, $20 million will be advanced to Motorola Finance Corp., a wholly owned subsidiary, for use in its retirement of part of its current bank loans and outstanding commercial paper; balance will be applied by the company to the repayment and retirement of its outstanding 4¾% term bank loans due 1965.

Electronic Associates, Inc., Long Branch, N. J., engaged in the development, production and sale of analog computers and related equipment, precision electronic plotting equipment and laboratory equipment; it also furnishes computer engineering services, involving problem analysis and solution, at three computation centers here and in Europe. Offering is 75,000 shares of capital stock for public sale; public offering price and underwriting terms to be supplied by amendment. Proceeds will be applied to the payment of an unspecified amount of demand notes payable to a bank under a credit agreement of April, 1960; balance will be added to working capital.

North Electric Co., Galion, Ohio, a manufacturer of telecommunications equipment, industrial switching and remote control systems, electromechanical and electronic components, and power supply assemblies used in computers and other electronic devices. Of-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- **Missile Systems—Largest supplier of accessory power units, AiResearch is also working with hydraulic, hot gas and hydrogen systems for missiles, liquid and gas cryogenic valves and controls for ground support.**
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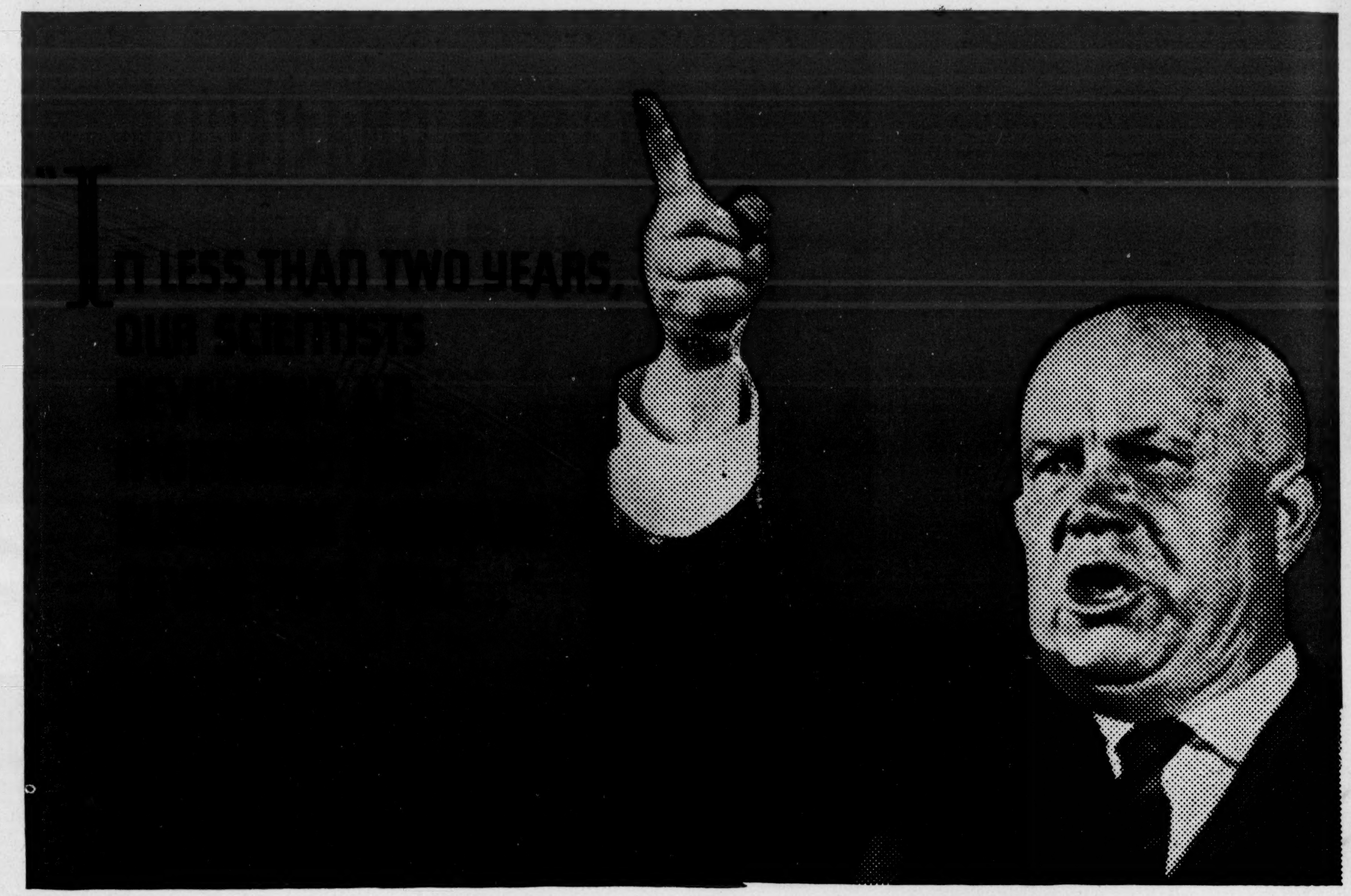
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fering is 22,415 shares of common stock, for subscription by stockholders of record on May 15, 1961; rate of subscription and subscription price to be supplied by amendment. Proceeds will be applied to working capital needs and to reduce short-term borrowings.

Friden, Inc., San Leandro, Calif.; principal products are calculators, adding machines, data processing equipment, mailroom equipment, Ticketograph machines, electromode heaters, etc. Offering is 360,000 shares of common stock; 150,000 shares for public sale by the company, and 210,000 outstanding shares by the present holders thereof. Proceeds of the company's sale will be used to provide tooling for new product models; to acquire machine tools and equipment for increased operating efficiency; to expand international facilities; for additional plant buildings; for prepayment of bank loans; the balance to carry larger inventories and trade receivables.

Arrow Electronics, Inc., Mineola, N. Y., engaged in the distribution of electronic components, parts and equipment as well as high fidelity, radio and television components and equipment, all manufactured by others. Offering is 165,000 shares of common stock, for public sale at $5 per share; offering to be made on an all or none basis. Proceeds will be used to repay an existing short-term bank obligation which was incurred to provide working capital; to expand sales, warehouse and office facilities; to acquire and equip additional sales outlets; balance will be added to working capital to be used for general corporate purposes including the purchase of more inventory.

Deluxe Coils, Inc. (now Wabash Magnetics, Inc.), Wabash, Ind., engaged in the manufacture and sales of epoxy encapsulated, microminiature and conventional coils for electrical and electronic industries, and in the manufacture of electronic equipment such as variable inductors and high voltage power supplies. Registration is 666,500 shares of common stock. Western Hemisphere Petroleum Corp., Tulsa, has been merged with and into Deluxe Coils, the continuing and surviving corporation whose name has been changed to Wabash Magnetics, Inc. Under the merger plan, the 666,500 shares of Western common became 666,500 shares of company stock, and the company's 450,000 shares continued outstanding; outstanding warrants to purchase 100,000 shares of Western common were converted into warrants to purchase a like amount of company common, and outstanding options and warrants for 261,320 shares of company common continued outstanding.

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Measurements and analysis of ICBM flight phenomena for discrimination and for decoy design purposes, including optical, aerodynamic and RF effects.

SYSTEM ANALYSIS

Studies to apply research findings to advance the technology of ICBM and AICBM systems.

INSTRUMENTATION ENGINEERING

Designing radar, optical and telemetry equipment with which to measure ICBM flight effects under actual range conditions.

RADAR SYSTEMS RESEARCH

Extending the theory and application of radar techniques to problems of discrimination, countermeasures and performance in a dense-target environment.

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RADAR PHYSICS

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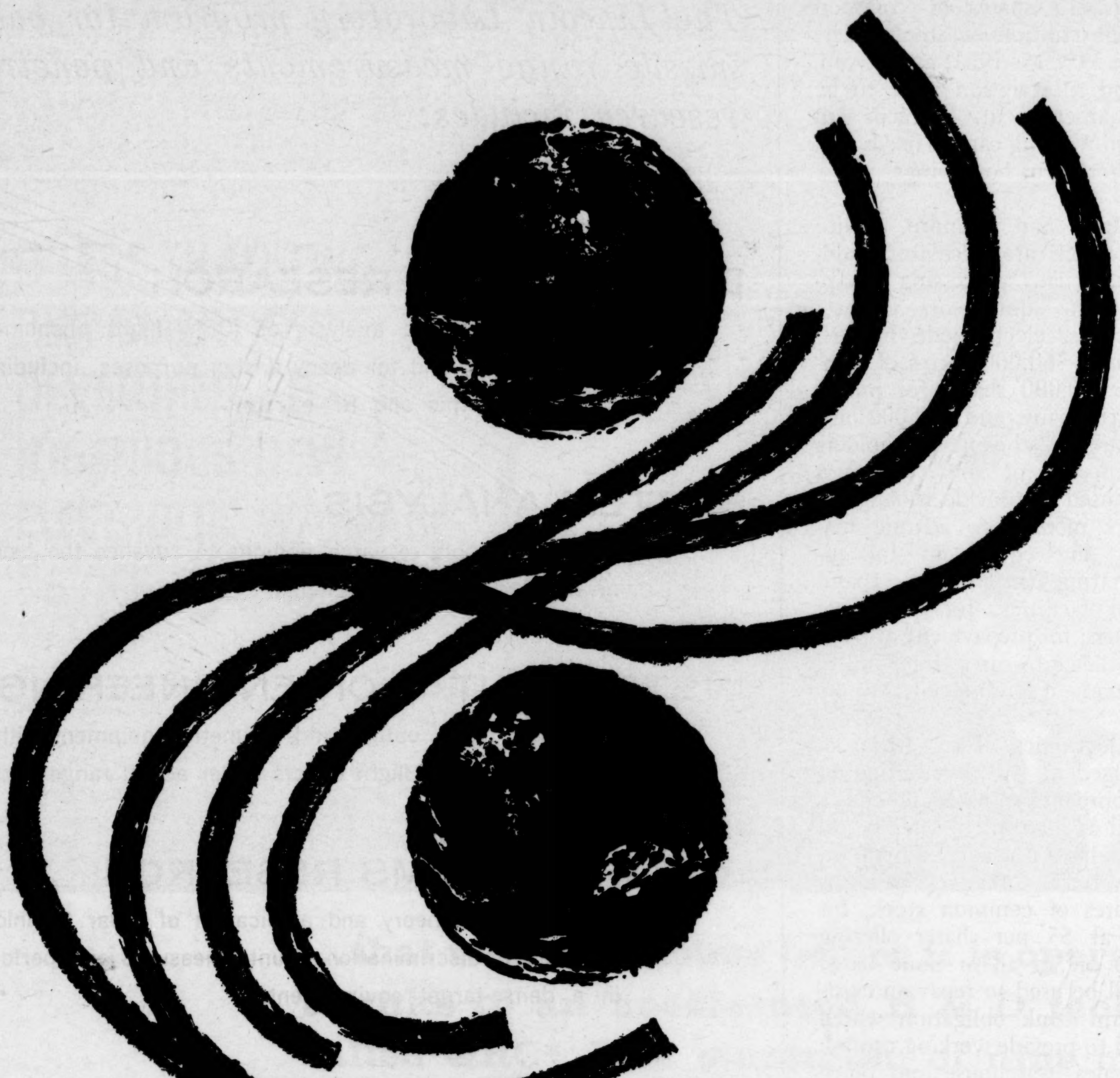

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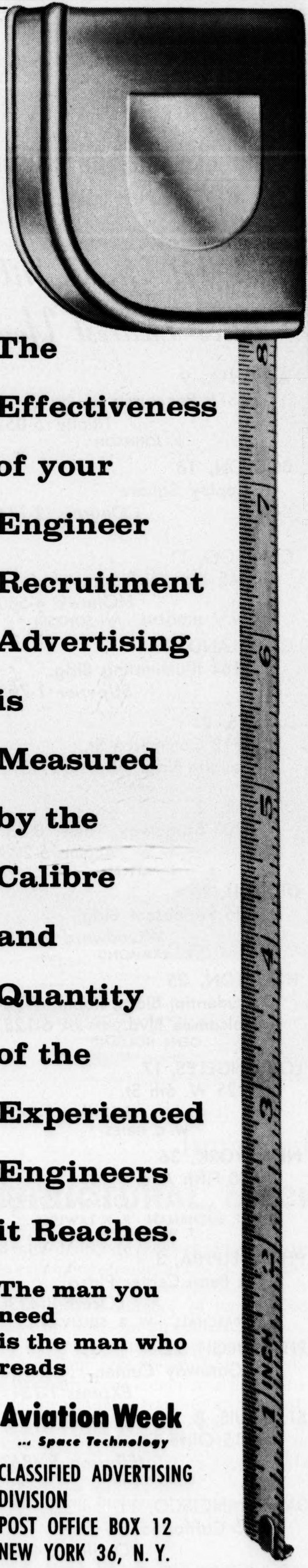

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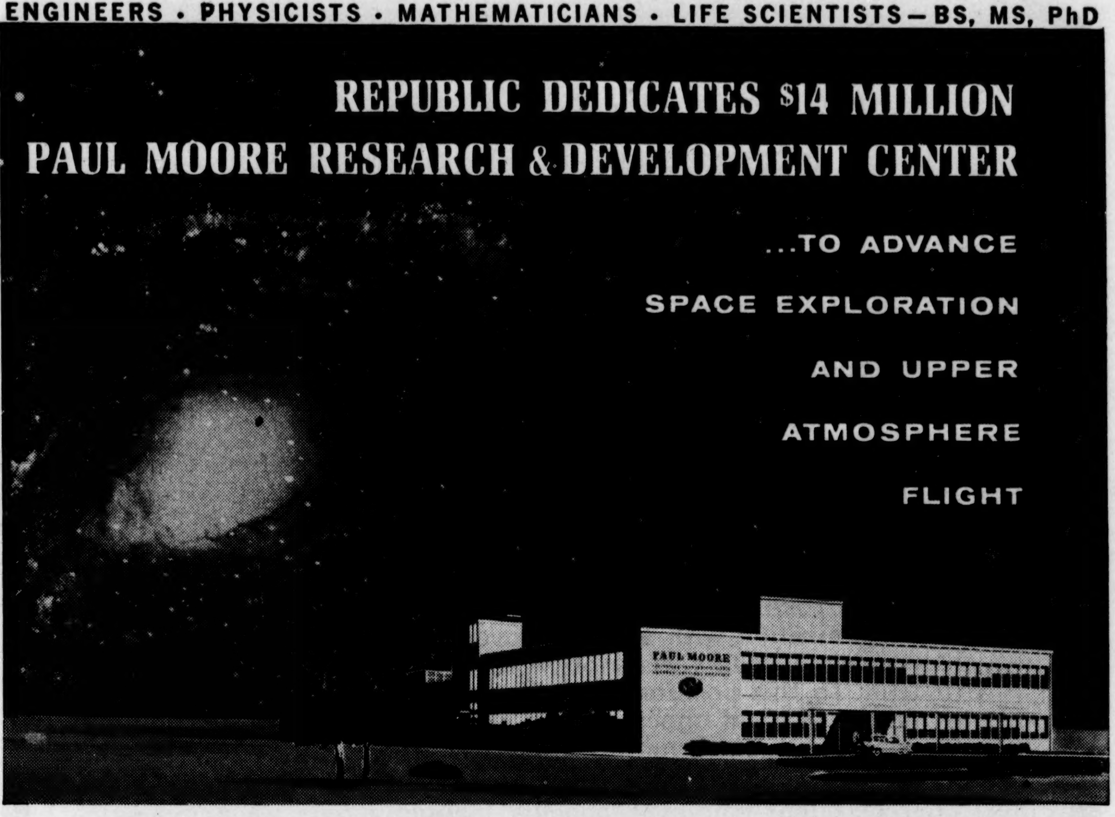

New Staff Appointments

IN EIGHT LABORATORIES

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STRUCTURAL ANALYSIS: thermal protection systems for re-entry vehicles.

STRUCTURAL THEORY: advanced problems in thermal & mechanical stresses of plate & shell structures, elastic and inelastic regimes.

STRUCTURAL CONFIGURATION RESEARCH: design problems of very large and/or lightly loaded structures; also heavily loaded vehicles.

STRUCTURAL DYNAMICS: preliminary design calculations of loads, stresses, deflections of structural components (aircraft, missiles, boosters, space vehicles).

THEORETICAL AERODYNAMICS & AEROPHYSICS: original work supporting design and laboratory project experiments re: hypersonic re-entry vehicles; supersonic craft.

AERODYNAMIC PROJECT DIRECTION: studies & appraisals of preliminary aerodynamic designs for diverse flight regimes, including drag analysis, configuration optimization, performance & trajectory analysis.

AERODYNAMIC ANALYSIS & SYNTHESIS: for both powered & ballistic trajectories.

MATERIALS DEVELOPMENT: refractory coatings on refractory metals, & refractory compounds, cermets, intermetallic compounds. Initiation of investigations to meet new requirements.

EXPERIMENTAL CRYOGENICS: establishment & supervision of cryogenics laboratory responsible for varied investigations including developing environmental control systems for spacecraft.

GUIDANCE & CONTROL SYSTEMS: novel components & system development; thin film devices; circuitry; optical & IR systems & tracking devices.

ELECTROMAGNETIC RESEARCH

BIOCHEMICAL DETERMINATIONS on men and plant systems.

MICROWAVE ANTENNA RESEARCH

OPERATIONS ANALYSIS

For detailed information about assignments in the above and other areas please write in confidence to: Mr. George R. Hickman, Technical Employment Manager, Dept. 1E-4

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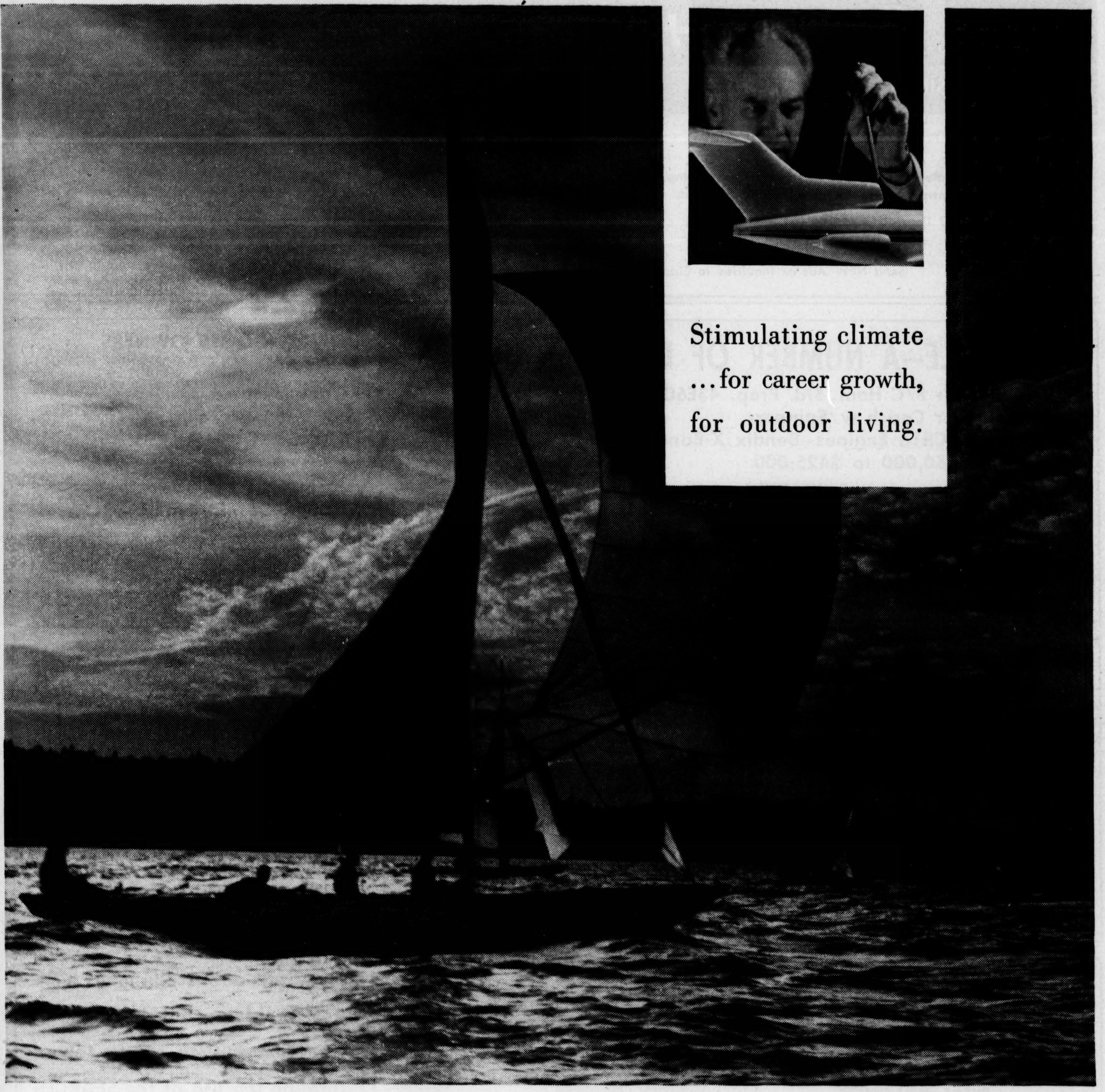

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LETTERS

Transport Coverage

I want to congratulate you on the fine job you and your staff did in the May 1 issue of Aviation Week that carried the 22nd Edition of Facts and Figures.

I felt the entire issue displayed a real knowledge of the industry and its problems, especially the editorial "Airlines in Transition."

S. G. Tipton
President
Air Transport Assn.
Washington, D. C.

720B Alternators

This refers to a statement contained in the Apr. 3 issue of Aviation Week which I feel is erroneous and thus may have created a false impression among your readers. The article on p. 32 concerning the recent Boeing 720B generator failures reported in part that ". . . Largely because Federal Aviation Agency had decreed that the four 720 alternators must be wired in parallel, malfunctioning of the diode resulted in a major power loss."

This would seem to imply that the Federal Aviation Agency had mandatorily required that the 720B electrical system be connected in a manner which could lead to the development of an unsafe condition. This is not the case, and I would like to clarify this point.

On the 720B, the generators can be operated in parallel with equal amounts of power being delivered to the total load by each generator, or they can be operated isolated, in which case each generator supplies only those loads connected to it. In either situation, an essential load bus, by means of a selector switch, can be connected directly to any one of the four generators.

Normally, as recommended by the manufacturer, all of the generators are operated in parallel. The prescribed procedure on the 720B is to operate all four generators in parallel on takeoff. This is done to ensure that power to the loads will not be interrupted during the critical takeoff period in the event of a generator failure. This provides the highest level of safety when the electrical system is functioning properly. Unfortunately, the systems involved in the 720B incidents did not in every instance operate properly, and electrical power to some circuits was interrupted as a result of the generator failures. However, parallel operation of the system was not responsible for the loss of power.

As pointed out in your article, the power failures were due to faulty diodes within the generators. The group of defective diodes has since been replaced with another type and the service experience on these is being closely monitored.

I am hopeful that you will utilize the foregoing information to set the record straight for the benefit of your readers.

W. H. Weeks, Chief
Engineering & Manufacturing Division
Bureau of Flight Standards
Federal Aviation Agency
Washington, D. C.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Mercury Pilots

Submitted is a bit of poetry on the light side with regard to the first manned space flight:

THUNDER THIEF

On May the fifth of Sixty-One
A Redstone launched with man number one,
He fared quite well the authorities say
For at zero G's he passed not away.
While the Russians claim the selfsame feat
And with respect to time they say they beat,
Yet the one who really deserves the praise
Is the banana eater of the study phase.
This chimp stood by thru thick & thin
And thru it all held high his chin,
Till after his first flight thru space
When his yen toward science had a change of face.
The second try to encapsule him
Caused his faithful trainer sordid chagrin,
For he clawed and fought with all his might
Applause be hung—this was Shepard's flight.
Now without a doubt the account will read
Of a man's contribution to scientific need,
Disregarding the monkey's trip thru space
Just because he had a change of face.

Paul Neuenswander
Administrative Engineer
General Dynamics Astronautics
San Diego, Calif.

Accelerating Defenses

The letter entitled "Anti-ICBM Concept" published May 1 (p. 168) in Aviation Week contends that the Nike Zeus anti-ICBM is an unnecessary weapon because the Polaris and Minuteman have the potential of completely discouraging any enemy from launching an ICBM at this country.

To make the foregoing concept complete, let us assume that the Russians are further along in the development of an anti-ICBM than are we in America. This assumption would be consistent with the steady trend of aggressive missile development in Russia. The Nike Zeus has been well publicized since 1957 and it is inconceivable that the Russians haven't undertaken a similar project and, in fact, pushed it for completion with considerable vigor.

With the perfection of an enemy anti-ICBM, and especially if this is done before the Nike Zeus is perfected and installed, it is obvious that enemy discouragement would not be complete.

Furthermore, the connotation of the cited letter is that mankind is entirely rational and not subject to panic, error, insanity or propaganda hypnosis. This is contrary to the lessons of history.

Another basic consideration is that if a squadron of controllable enemy bomber satellites were placed in orbit about the earth and if allowed to flagrantly continue in orbit, an untenable threat would exist. Only the Nike Zeus currently has the potential of anti-satellite activity in the free world.

The foregoing totalized concept speaks undeniably for an accelerated anti-ICBM and anti-satellite program.

C. W. Ranson
Los Angeles, Calif.

Space Economics

In your editorial of Apr. 17, you weep over Maj. Gagarin being the first to be sent (repeat, be sent) a-orbiting, then you talk about "the Nation" that could carve Wright in the granite of Kitty Hawk. Don't forget that it took another generation to bring the Wright bi-plane back from England, to even admit that "the Nation's" Dr. Langley was beaten to the punch in starting the aerospace age.

While Maj. Gagarin's boys were getting ready to see how far they could throw him, "the Nation" was spending megabucks on three "tail sitter fighters" that could barely lift their own weight. Since then they have spent megabucks more on all sorts of flying (?) testbeds that a high school student could have figured wouldn't work.

I suggest you take a look at the report Sikorsky recently got out for the government about the VTOL fiasco, where if they couldn't make the first one work they went ahead and built who knows how many more all at public expense. There are some pretty good proposals in the files of government agencies that are pushed aside because of financial weakness on the part of their backers, or even some misdirected prejudice in military circles. But because a researcher or his company couldn't pay the janitor, let alone the chairman of the board, their ideas are no good.

It could be that Maj. Gagarin's ride is the result of someone knowing what it's all about. Let's persuade our boys to look around, just to see if possibly they are missing something good? Even if the boys who have it haven't a window to throw it out of.

Stephen du Pont
Southbury, Conn.

It Could Be Worse

Not being the country with the first man in space is bad enough—it could have been embarrassing if the Russians had used a Mercury capsule.

Murray Ogman
San Diego, Calif.